CANADIAN ELECTRONICS ENGINEERING

FEBRUARY 1960
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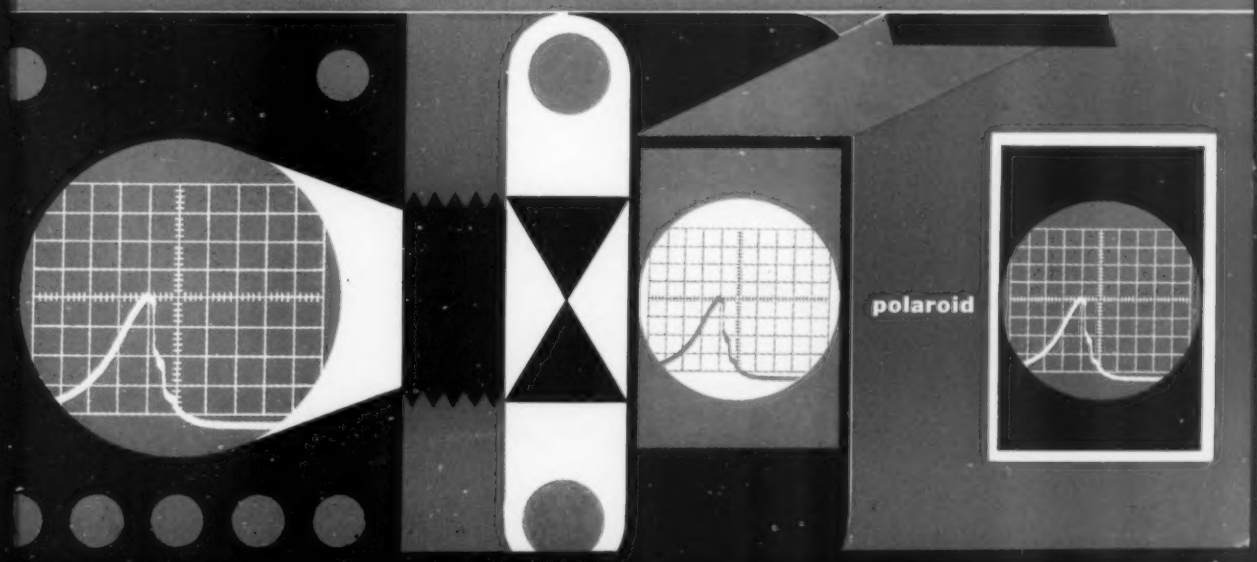

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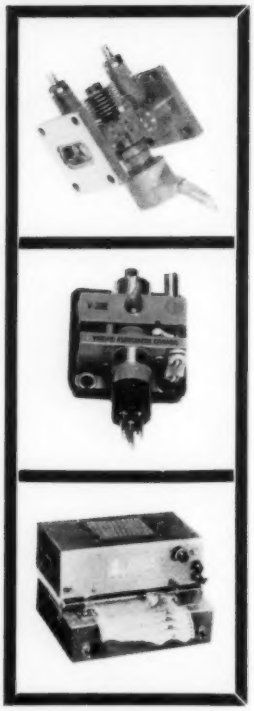

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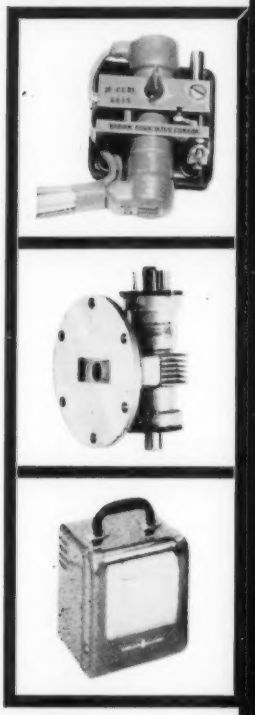

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February, 1960

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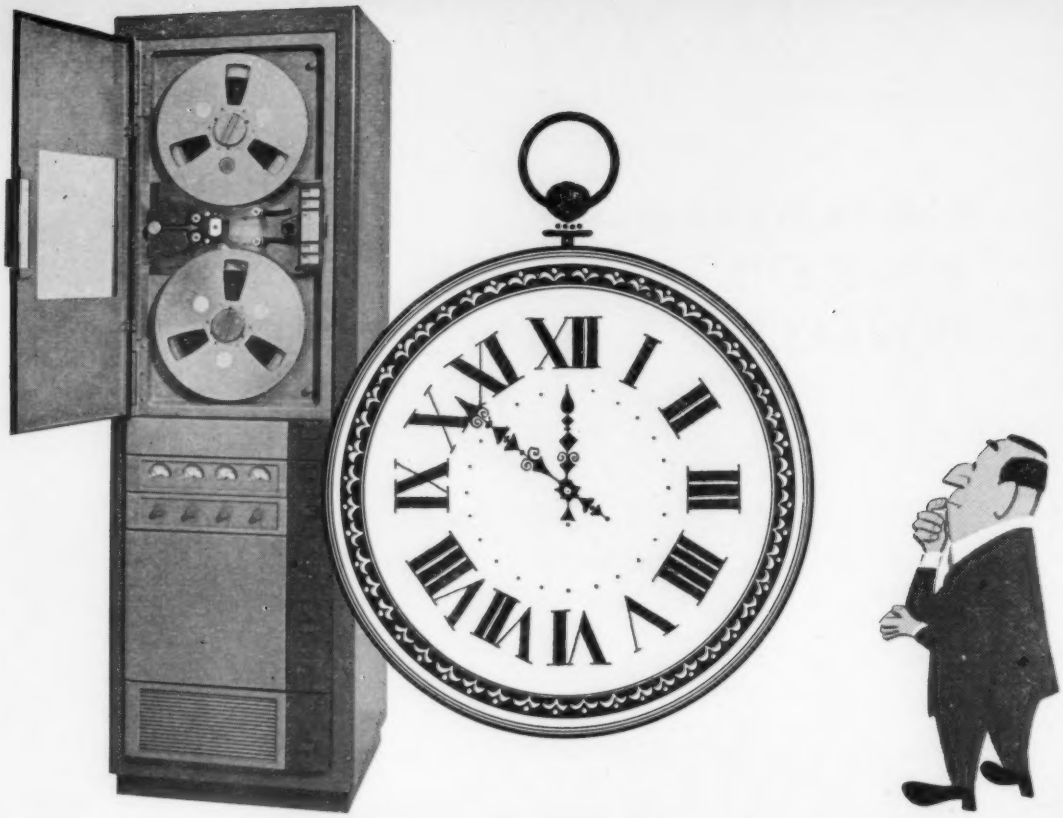
***cover design**

Cover artist Hans Kleefeld enjoyed this assignment. The oscilloscope trace patterns had interesting and artistic shapes. In fact, he incorporated an actual photo of one in his cover design.



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magnetic tape recorder gives you a 5-minute hour or a 300-second minute

The FR100B is the workhorse of the laboratory, with versatile time base expansion and compression which enables you to accommodate any speed for accurate data storage.

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Indexed in Engineering Index.

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authors and articles in this issue:

One of the quiet revolutions that has taken place in the electronics industry is the technique of recording traces on cathode ray oscilloscopes. The feature article in this issue of CEE (New Photographic films and techniques aid CRO trace recording) gives a comprehensive picture of the state of the art today. Although the story has been credited to two authors, many people had a hand in the preparation, including equipment manufacturers, laboratory personnel, and the public relations department of Polaroid Corporation.

Kemon P. Taschioglou has been with Polaroid Corporation since 1953 and since 1955, he has been working in the area of technical and industrial applications of picture-in- a -minute photography. Overwhelmed with enquiries about photographing oscilloscope traces, he began researching the CRO field more than a year ago. This story is the result of his research.

Taschioglou

In 1949 Mr. Taschioglou received a BS degree in electrical engineering from Massachusetts Institute of Technology, and two years later he received a master's degree from Harvard University Graduate School of Business Administration.

H. P. Mansberg is a Senior Engineer in the Medical and Biological Physics Department of Airborne Instruments Laboratory, Mineola, Long Island.

Mansberg

Prior to joining AIL, he was associated with the Allen B. DuMont Laboratories, Clifton, N.J., for 13 years in the capacities of project engineer, section head and then manager of applications engineering and market research. During this time, Mr. Mansberg spent a number of years on the development of oscilloscope cameras and in the investigation of cathode ray tube photo recording techniques. This resulted in acquiring patents on oscilloscope camera designs and in the preparation of papers for publication in various technical journals.

H. C. Ratz, P.Eng., (Industrial process data reduction) obtained his BASc degree at the University of Toronto in 1950, and later added an SM from MIT. After several years as a design engineer with Fischer & Porter (Canada) Ltd. in Toronto, he moved last year to a post as senior research associate at the University of Saskatchewan, where he is working on advanced process control systems.

Michael Barlow (Are your schematics doing their job?) was born in London, England, and educated at King Williams College, Isle of Man. After National Service in the Royal Signals at Catterick, he went to Cambridge, finishing up with an MA. A post-graduate course at the Marconi College was followed by five years in the TV development labs of that company working on TV transmitters. Mr. Barlow came to Canada in 1957 and is currently a development engineer with the Canadian Marconi Co. He is an AMBritIRE and a member of the Society of Motion Picture and Television Engineers. He has freelanced in technical journalism for many years, and for 9 years edited "CQ-TV", journal of the British Amateur Television Club. For the moment he has given up amateur radio and TV to permit more time for home movies. Now he edits the "Eight-Sixteen Reporter" of the Montreal Movie Club.

Barlow

Mr. Barlow's main concern is that the DO staff at Cdn. Marconi Co. may not speak to him again after reading his article. (The atmosphere has been a bit chilly in this office, too. — Ed.).

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NEWS HIGHLIGHTS

U. S.-Canadian defense production sharing is now a reality. Several contracts were received by Canadian electronics firms in 1959.

Although there is no indication yet of the amount of business placed in Canada by the U. S. services and their prime contractors, details were recently announced of a $1,350,000 contract awarded to Raytheon Canada Ltd. by the Canadian Commercial Corporation. Raytheon will produce in their Waterloo, Ont. plant 60 transistorized position indicator units for installation in SAGE information centres. Each unit will receive radar information from the DEW line, display it on a 'scope and record range and azimuth for each target on a printed tape.

Look for more leasing, rather than purchase, of production and test equipment by Canadian firms; trend is well-established in the United States.

Long-term leasing of production equipment by U. S. electrical and electronics manufacturers during 1959 spurted ahead, reaching a total of $23.6 million worth of equipment on lease, a gain of 39% over 1958. This activity is expected to double in 1960 because of three factors: (1) more equipment manufacturers are using leasing as a sales tool to move their products; (2) more companies will lease their equipment to avoid the pinch of tight money and gain a tax advantage; and (3) more companies will be affected by the increasing technological progress that is speeding up obsolescence of equipment. Canadian-Dominion Leasing Corporation Ltd. of Toronto was recently incorporated to provide a nation-wide service of diversified equipment leasing in Canada.

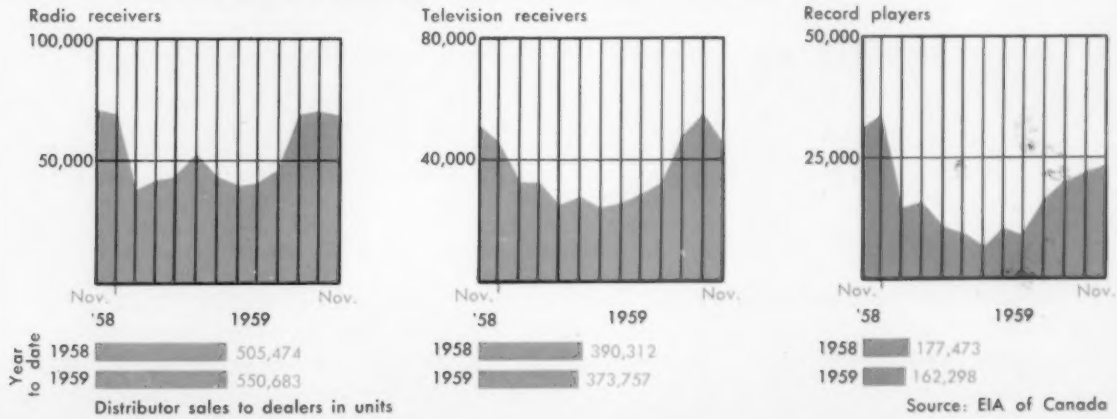
Canadians will have to wait at least another three months for the advent of regular stereophonic radio.

This is the effect of a decision by the National Stereophonic Radio Committee of the U. S. Electronic Industries Association to postpone recommending an FM stereophonic radio system to the Federal Communications Commission until March 31. Further tests are necessary to evaluate various proposed systems. AM and AM/FM systems are also under study. The Canadian Radio Technical Planning Board are expected to recommend to DOT that Canada uses the same system as the U. S.

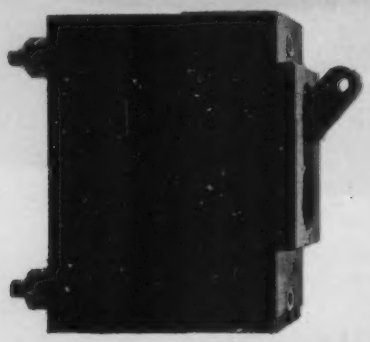
Westrex Corporation has purchased the patent rights and tooling of a Canadian-developed teleprinter.

The teleprinter was designed by Ronald G. Griffith, vice-president and chief engineer of Canadian Overseas Telecommunication Corporation; tooling and pre-production models were made by Jay Flex Ltd., Montreal jewelry manufacturers. It is regrettable that obstacles developed precluding manufacture in this country. Westrex, a division of Litton Industries Inc., will manufacture and market throughout the world the transmitting and receiving teleprinter, which can also be used as a computer read-out device.

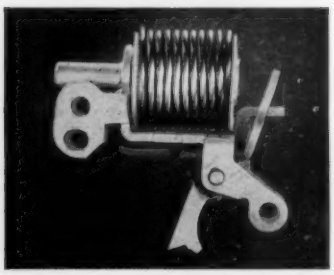
Radio sales slightly down in November, but 11 months total up 10%



NO HIGH-AMBIENT DE-RATING!



HEINEMANN CIRCUIT BREAKERS HOLD THEIR RATING AND TRIP POINTS AT ANY TEMPERATURE



Here you see the overload-sensing element of a Heinemann circuit breaker. Its unique type of magnetic actuation is functionally independent of temperature effect. Operation is based on actual load current —not on current-produced heat, as is the case with thermal-type devices. Consequently: current ratings hold constant at 100% nominal value, set trip-points stay fixed at specified overload percentages regardless of the ambient. Performance is always predictable, consistently dependable. Think about it: wouldn't your equipment gain added reliability with such built-in, temperature-stable protection? The Heinemann *Circuit Breaker Engineering Guide,* Bulletin 201, has all the technical details you'll want to know. Write for a copy.

HEINEMANN ELECTRIC COMPANY 166 PLUM ST., TRENTON 2, N.J.

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Ontario engineers elect Simmons president for 1960

The 18,500-member Association of Professional Engineers of Ontario has elected **Dwight S. Simmons,** P.Eng., of Toronto, as its 1960 president. He succeeds A. W. F. McQueen, P.Eng., of Niagara Falls, Ont. Born in Sarnia, Ont., Mr. Simmonds graduated from Queen's University in mechanical engineering in 1932, and has been with Imperial Oil Ltd. since that time. At present he holds the position of general manager of manufacturing. He has served on the APEO's executive council for five years and last year was the Association's 1st vice-president.

Elected 1st vice-president for 1960 is **Lawrence C. Sentance** of Hamilton, manager of the defence apparatus division and atomic energy division, Canadian Westinghouse Co. Ltd. The 2nd vice-president is **Robert L. Hicks** of Toronto, assistant to the engineer, distribution planning and design, Toronto Hydro.

Automatic Electric sales appointments

Automatic Electric Sales (Canada) Ltd. has appointed **John R. Simpson** as radio sales specialist, carrier and radio division. **Richard A. Oliver** has been appointed sales representative on carrier and radio products. Mr. Simpson will be located at the company's head office in Toronto, and Mr. Oliver will be located in Montreal

Data processing market manager

Honeywell Controls Ltd. has appointed **Patrick J. Suddick** to the position of market manager, electronic data processing division. He will be responsible for the marketing and sale of the Honeywell 800 electronic data processing system.

Mr. Suddick graduated from the University of Toronto in 1949 with a B.Sc. in engineering and business. He joined Honeywell Controls Ltd. in 1953.

RCA Victor Co. Ltd. directors

At a recent meeting of the shareholders of RCA Victor Co. Ltd. in Montreal, **Daniel Doheny, Q.C. and J. Gerald Godsoe, C.B.E., LL.D.** were elected as directors of the company.

BATTEN

Doheny

BATTEN

Godsoe

Mr. Doheny, a partner of the Montreal legal firm of Bourgeois, Doheny, Day & Mackenzie, replaces the late Aubrey H. Elder, Q.C., who served for many years as a director of the company. Mr. Godsoe is also a director of the Crown Life Insurance Co., Dominion and Anglo Investment Corp., The Great Western Garment Co., and other companies.

Executive appointments

G. Douglas Zimmerman has been elected executive vice-president and director of Canadian Curtis-Wright Ltd. of Montreal. He has also been named managing director of the Canadian operation. Prior to this, Mr. Zimmerman was president and a director of Fischer & Porter (Canada) Ltd. in Toronto, and a director of Fischer & Porter Co. of Hatboro, Penna. He is also president and director of C. P. Clare, Canada, Ltd. of Toronto, and a director of Industrial Wire and Cable, Ltd. of Toronto.

Succeeding Mr. Zimmerman as president and director of Fischer & Porter (Canada) Ltd. is **D. A. McCammon, P.Eng.** Mr. McCammon has been with the company since 1950 serving as industrial manager.

Electronic controls sales engineer

Manning, Maxwell & Moore of Canada Ltd., Galt, Ont., has appointed **E. W. Ankenman** sales engineer in Eastern Canada for Microsen electronic controls. Educated at the University of Toronto, from which he graduated in 1952, Mr. Ankenman joined the company in 1956 after three years as a sales engineer for the G. W. Beecroft Co. Ltd. He is a registered professional engineer, a member of the Instrument Society of America, and holds a reserve commission in the Royal Canadian Navy as a lieutenant in the engineering branch.

Contracts administrator

Collins Radio Company of Canada Ltd. has appointed **Michael F. Phillips** to the position of contracts administrator. A graduate in physics from the University of London, Mr. Phillips joined Canadian Westinghouse Co. Ltd. on arriving in Canada in 1953. During the past three years he has been employed by the Dept. of Defence Production, latterly as chief of the Sonar Div., Electronics Branch.

ASHLEY & CRIPPEN

Phillips

Stedman

NRC scientist moves to U.S.A.

A former technical officer with the Radio and Electrical Engineering Div. of National Research Council, Ottawa, **B. D. Stedman,** has joined Federal Electric Corp. and will be working on the Dew Line. Mr. Stedman was born in Woking, Surrey, England, and obtained the Higher National Certificate in electrical engineering at Reading Technical College in 1957.

(Continued on page 60)

TRUSSLER

Simpson

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Oliver

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FEDERAL PUTS A TWIST IN TELEPHONE CABLE

Special 'Unilay' Construction

Twist it's open . . . twist it's closed! Just as simple as that, this one-direction cabling technique gives easy access to inner conductors . . . makes possible faster, more efficient mid-span taps.

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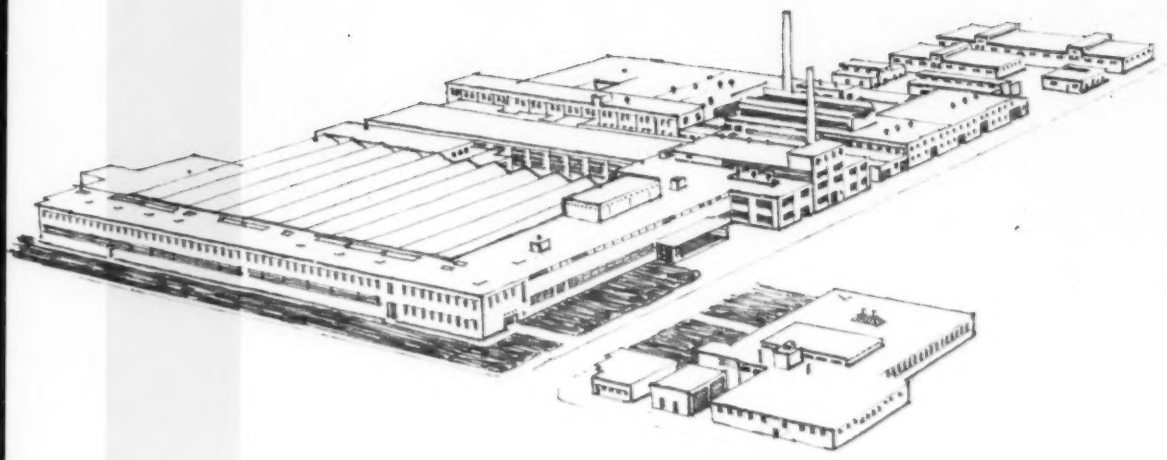

The Rogers Majestic Mobilophone 2-way radio is a completely new 2-way radio, designed with skill and know-how gained by years of experience in developing and producing mobile and other industrial communications equipment. Over ten years of experience in the field have given Rogers Majestic communications equipment the reputation of peak performance under all conditions.

Mobile radio enables you to have direct communications with your mobile vehicles at all times and save on operating costs by eliminating unnecessary mileage and loss of time caused by normal check-in calls. With the Rogers Majestic Mobilophone, you can redirect your mobile vehicles immediately to meet emergencies, change in plans or new work.

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- Power amplifier (5894A) features hard glass envelope and rugged construction, vibration and shock resistant.
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- Standard 60 Kc channel spacing or 30 Kc split-channel.
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- Transistorized dynamic microphone.
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- Up to two channel operation.
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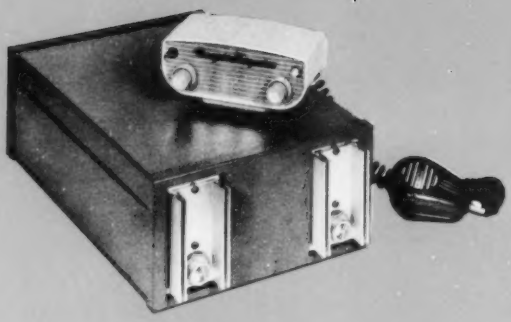

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STREET RAILWAYS
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Winnipeg Electric Co., Winnipeg, Man.

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Next IRE Canadian Convention will be held in 1961

The fifth Institute of Radio Engineers' Canadian Convention and Exposition will be held in Toronto in October, 1961, Fred Heath, chairman, IRE convention committee, announced today.

"Postponement for a year will pave the way for an expanded technical program and increased industry participation in an exposition featuring more electronic and nucleonic developments," he stated.

The decision to hold the fifth IRE Canadian convention in 1961 instead of 1960 followed a study of replies to questionnaires sent to previous exhibitors and a meeting in Toronto of IRE and Electronic Industries Association officials. A contributing factor, cited by A. P. Barclay, director IRE Canadian region, was a lack of unanimity among exhibitors on the wisdom of holding a 1960 convention. Eighty-four of 134 exhibitors who returned questionnaires were in favor, but a stronger showing was considered necessary to guarantee success of a 1960 meeting, Mr. Barclay stated.

Another factor in the decision was the conflict of dates with the National Electronics Conference in Chicago. This could not be avoided in 1960.

Thirty-two of the exhibitors thought the place of the conventions should alternate between Toronto and Montreal, but a substantial proportion of the remaining respondents recognized the problem of finding a suitable location in the latter city for a convention of this magnitude.

In making today's announcement, Mr. Heath said that the appointment of the convention committee responsible for organizing the 1961 Canadian convention would be announced shortly. "With 18, instead of nine months for planning, the committee should be able to arrange for more participation by scientific agencies of overseas governments and for a convention of still greater interest and significance for all delegates and visitors," he said.

C.D.C. to make navigation system for new RCAF fighters

Computing Devices of Canada Ltd. has received a $4 million contract to produce over 200 automatic dead reckoning navigation systems for the CF-104G Starfighters which will replace the RCAF's Sabres in Europe. The system, to be known as the Position and Homing Indicator Mk. 5, will be similar to that already in production at the firm's Ottawa plant for the West German Air Force.

C.D.C. project engineer Ed Hammond shows computer and indicator units of the PHI. A third unit, the station selector, completes the system.

Reviewing the history of the PHI, C.D.C. president C. F. Hembery explained that it was originally developed for the RCAF, and the first prototype was test flown in 1952. "The PHI is an entirely Canadian concept and achievement," he said, "and I would like to pay tribute to the foresight of the RCAF and DDP in sponsoring the advanced development of dead reckoning navigation equipment in Canada."

New appointments

Stark Electronic Sales Co., Ajax, Ont., has appointed Electro Sonic Supply Co. Ltd., Toronto, as distributor of the Stark Gold Brand line of meters. Territory runs from Hamilton through to Ottawa, including Metropolitan Toronto.

Charles W. Pointon Ltd., Rexdale, Ont., is now Canadian sales representative for Sterling Precision Inc., Instrument Division, Port Washington, N.Y. (complete line of standard precision electro - mechanical servo components).

Comptronics, 2 Hanford St., Seattle 4, Wash., represents Trio Laboratories Inc., Plainsview, L.I., N.Y., in Western Canada (precision miniature panel mounting vtvm's).

(Continued on page 60)

Ottawa report

What's the secret of success in the highly competitive export market for Canada's engineering industries?

After going over contracts from abroad worth some $140 million in recent months, R. A. Frigon, chief of the Trade Department's engineering and equipment division, says the important factors include: price, design, delivery, personal contacts, payment terms.

When interviewed by CEE's Ottawa editor, Mr. Frigon cited as an example a $1.5 million contract for Radio Engineering Products Ltd. of Montreal to supply carrier telephone equipment to Sweden.

"This is a significant accomplishment because Sweden has a reputation of its own in the telephone field," Mr. Frigon said. "The company believes that progressive engineering design is as important as price. It keeps continuous personal contact with all levels of the organization to which it sells, and pays scrupulous attention to specifications and to making deliveries on time. These factors operated in the sale to Sweden."

It isn't the automation, it's the sudden shift.

Touching on organized labor's view of automation in a recent speech, President Claude Jodoin of the Canadian Labor Congress said:

"We are not opposed to automation and other changes which will bring increased efficiency. We do think there is a very real need for advance warning of these changes and of carefully planned programs to avoid the human suffering and wastage which can so easily result without planning of this kind."

What was the primary force behind the estimated 7% increase during 1959 in Canada's gross national product?

In his year-end review of 1959 economic developments in Canada, Trade Minister Churchill offers this explanation: "The growing needs of the Canadian people, whether for public facilities or for goods and services, have given the dominant push to the present upward surge of productive activity."

Looking to the future, he suggested: "The consumer market in particular gives promise of continuing buoyancy in the period ahead."

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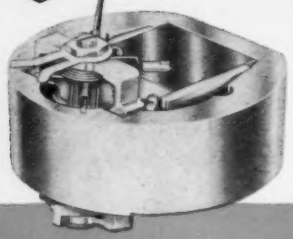

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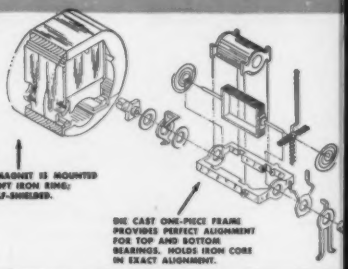
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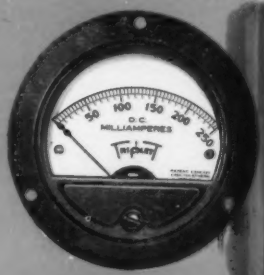
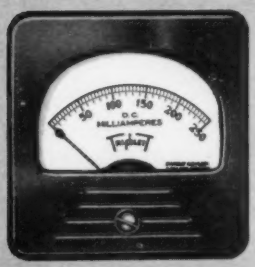
Rectangular Flush Mounting (3 5/16")
Model: DC 327-PL, AC 337-PL, RF 347-PL

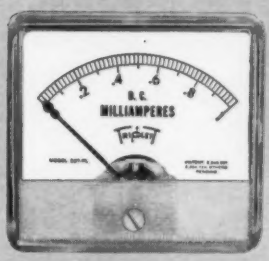


Round Flush Mounting (3 1/2")
Model: DC 321-T, AC 331-S, RF 341-T, Dyn. 361

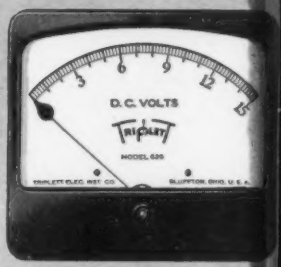


Rectangular Flush Mounting (2 5/16")
Model DC 227-T, AC 237-S, RF 247-T

Rectangular Flush Mounting (4 5/16")
Model: DC 420-PL, AC 430-PL, RF 440-PL



Rectangular Flush Mounting (2 1/16")
Model: DC 227-PL, AC 237-PL, RF 247-PL



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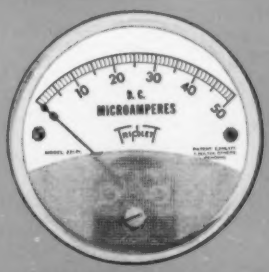
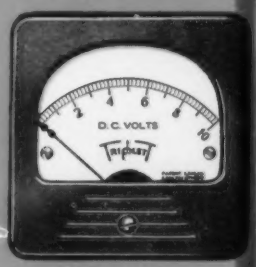


Round Flush Mounting (2 1/16")
Model: DC 221-PL, AC 231-PL, RF 241-PL



Rectangular Flush Mounting (3")
Model: DC 327-T, AC 337-S, RF 347-T, Dyn. 367-A

For complete details see your Electronic Parts Distributor, or write

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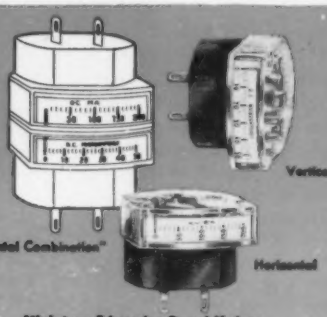

Miniature Edgewise Panel Meters
—Model 120

Model 327-U Unimeter 3½"
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Model 420-U Unimeter 4½"
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Model 334 Unimeter Stand

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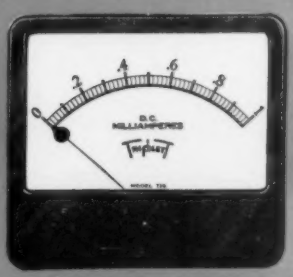

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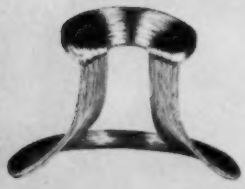
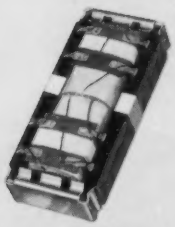
A Formel insulated wire with a thermoplastic cement overcoat. This overcoat softens when exposed to heat (275°F) or solvents (alcohol). Will bond the wires in a desired shape on cooling.



Deflection Yoke Coil for Television

NYLON

A polamide coating wire characterized by excellent windability and ability to solder in dip operations at temperatures of 650°F. to 750°F. without prior removal of coating.



Fluorescent Lamp Ballast Transformer Coil

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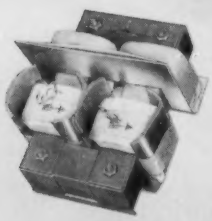
Insulated with an oil resin varnish film. Provides outstanding electrical properties in very thin film build-ups.



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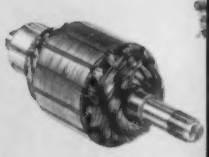
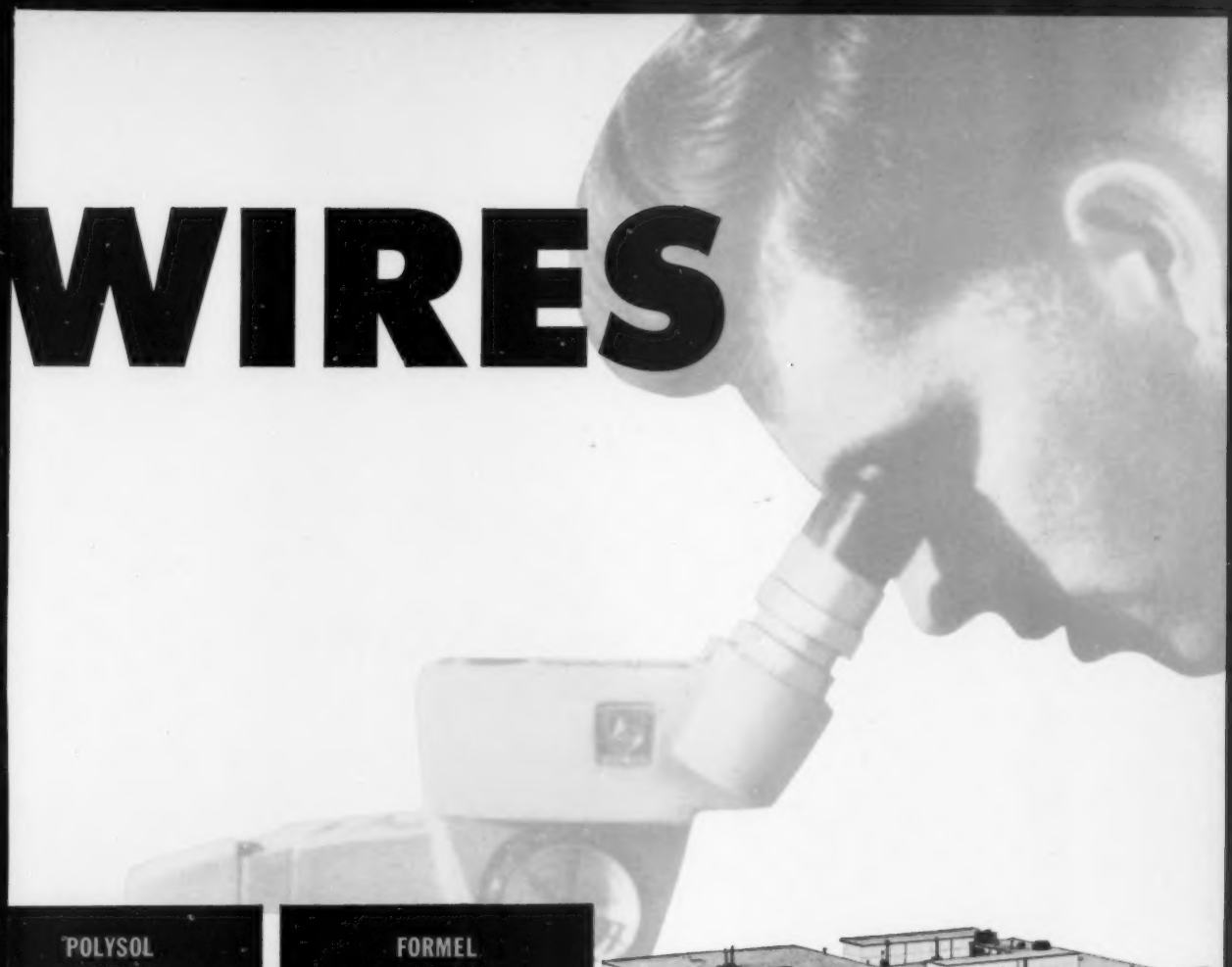
Polysol insulated with a nylon overcoat. Combines the excellen windability and solvent resistance of nylon with the outstanding electrical characteristics of polysol. For soldering in dip operations without prior removal of coating.



Automotive Generator Armature

WIRES



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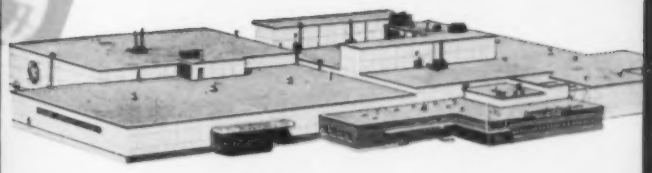

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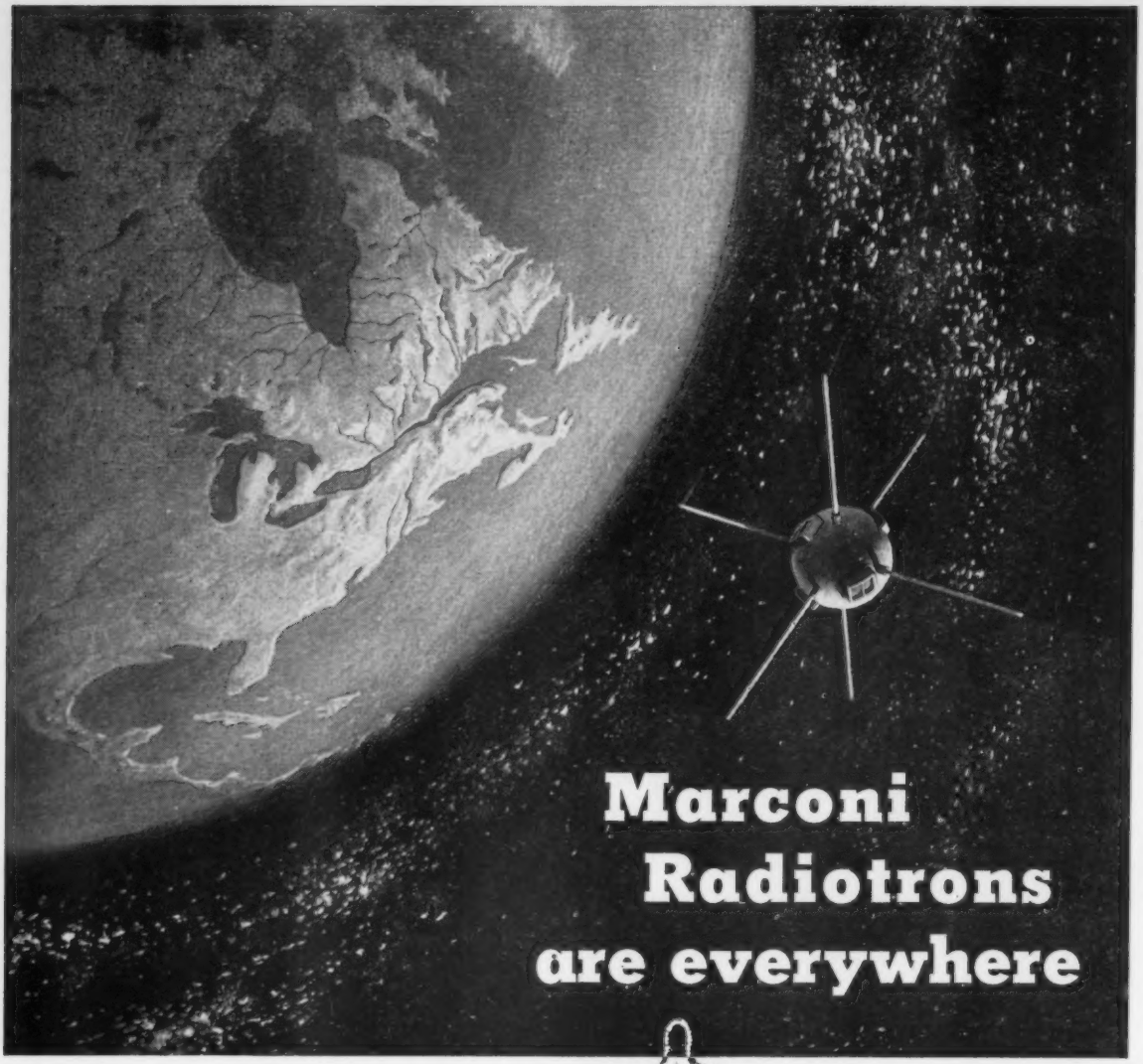

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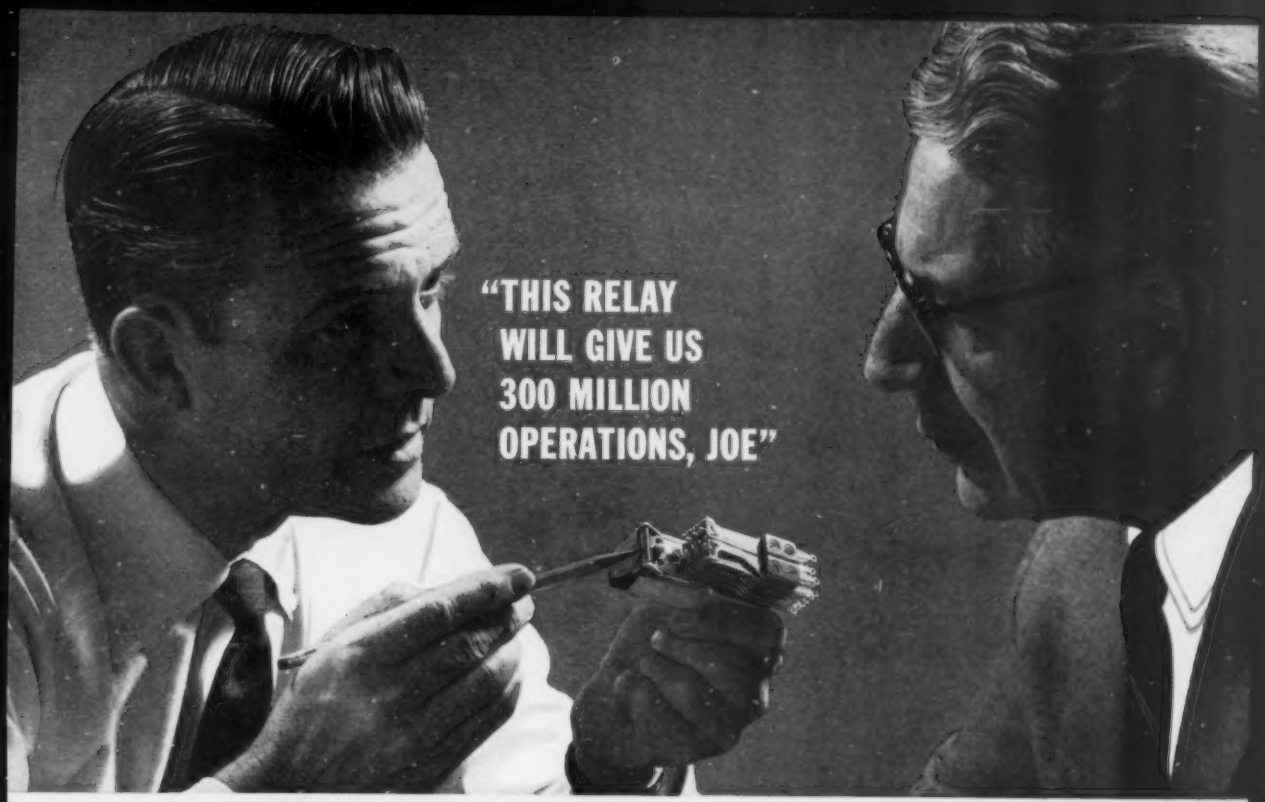

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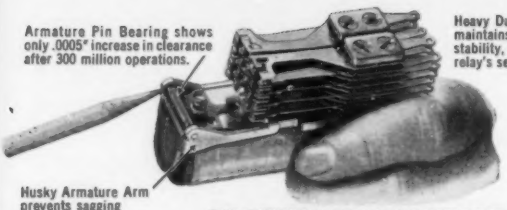
reliable performance over long life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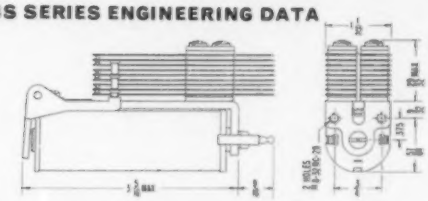

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Ambient Temperature: −55° to +85° C. +125° C available on special order.
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Terminals: Pierced solder lugs; Coil: One #16 AWG wire Contacts: Two #18 AWG wires
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CONTACTS:
Arrangements: DC—up to 28 springs AC—up to 24 springs
Material: 1/16" dia. twin palladium. Up to 1/4" dia. single silver. Other materials on special order.
Load: 4 amps at 115 volts, 60 cycle resistive
Pressure: 15 grams minimum

COILS:
Resistance: 100,000 ohms maximum
Current: 10 amps maximum
Power: DC—50 Milliwatts per movable arm. Greater sensitivity on special order. AC—17.9 volt-amps.
Duty: Continuous
Treatment: Centrifugal impregnation
Voltages: DC—up to 300 volts with series resistor. AC—up to 250 volts, 60 cy.

MOUNTING: Two #8-32 tapped holes 3/4" o.c. Other mountings on special order.

GS SERIES—Excellent sensitivity: 50 mw per movable arm minimum (DC). For applications requiring many switching elements in small space.

LS SERIES—Medium coil relay with short springs and light weight armature for fast action, reliability and long life.

TS SERIES—Short coil relay is available in AC and DC versions. Long life construction. Can be supplied (DC) with up to 20 springs (10 per stack).

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New, no-jam electric head eliminates down time...and the need for pressurized air. Fewer parts minimize maintenance — ensure quieter, more positive operation.

Wide range of hole punching capacities...from a 3½" hole (round or shaped) in 16 gauge to a ½" hole in ¼" mild steel.

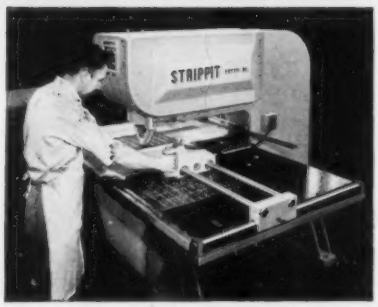
Corner and edge notching...up to 5" x 5" in 16 gauge mild steel — 90° corners, rectangular, vee, radii and special shape edge notches.

Straight line nibbling and contour shearing...at 165-strokes per minute in ⅛" mild steel. Instant changeover from single stroke punching.

New swing-shift punch holders...quick-opening, positive-closing — for right or left-hand operation. Electrical interlock for safety.

Exclusive quick-change tooling system...using standard stock punch and stripping guide assemblies and die buttons. Size changes take less than 20 seconds.

New quick-set gauging system...with micrometer settings for fast, accurate layout and rapid work positioning.



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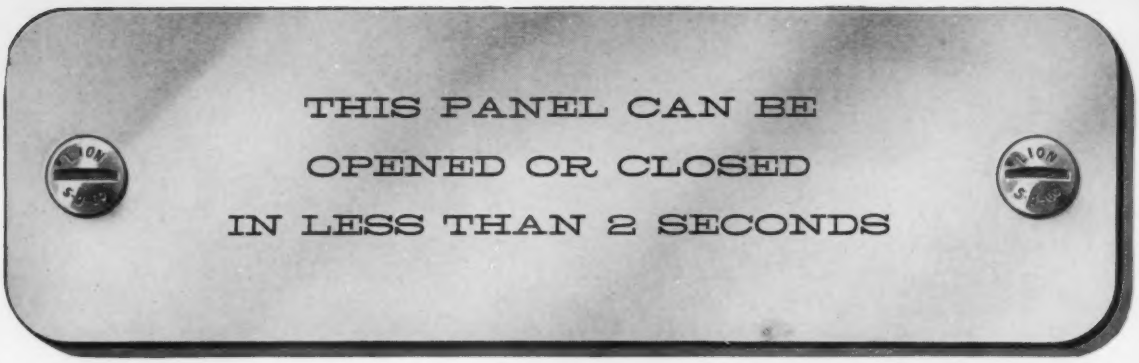
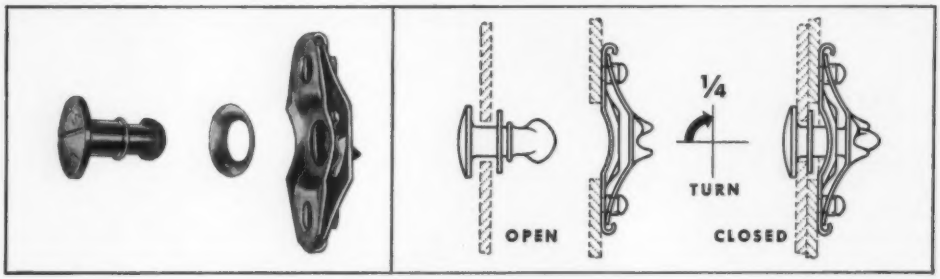


LION ¼ TURN OPEN ¼ TURN CLOSED FASTENERS

ARE FAST, POSITIVE, RELIABLE



Installation of the three parts of the Lion Fastener, shown above, is quick but not critical. Unique in design and performance, these mil spec (MIL-F 5591A-ASG) fasteners make possible quick access and smooth positive locking by only a ¼ turn.

ALIGNMENT NOT CRITICAL

Both stud and receptacle "float" to accommodate misalignment. The hole, which retains the stud, is twice as large as the stud cross-section. This permits a float of .070 in all directions. The leaf spring receptacle also floats to accommodate stud position.

WIDE VARIATIONS IN STACK HEIGHT

Total sheet thickness may vary as much as +.035 and −.015 without affecting operation. A Lion stud, specified for .160 total thickness, for example, will accommodate any stack height between .195 and .145.

SWAGED-NOSE STUD

Extra strength and smooth operation are made possible by the swaged-nose design. All the metal in the stud goes to work. There are no thin cross pins, holes or milled slots to weaken the cross-section. Case hardening is further assurance of long, trouble-free service.

WIDE VARIETY

Lion Fasteners are available in 3 sizes—No. 5, No. 2, and Miniature. An assortment of head styles are supplied—oval, flush, wing, ring, notched or knurled—according to individual requirements.

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380 Donald Street
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Clip and file this reference sheet for future use

ROGERS

REFERENCE BULLETIN NO. 5

Use Philips Tube Type 5842/417A for Special Quality Applications

For special quality equipment you should use special quality tubes and components assembled by highly skilled personnel and machines. The Philips tube type 5842/417A has been designed for grounded grid applications in HF and IF broadband amplifiers where peak performance and long life is a basic requirement. The 5842/417A is a miniature triode featuring high transconductance, low microphony and high gain. It is also shock and vibration resistant.

TECHNICAL DATA

MECHANICAL

Cathode	coated, unipotential
Bulb	T 6½
Outline	6-1
Base	E9-1
Mounting position	any

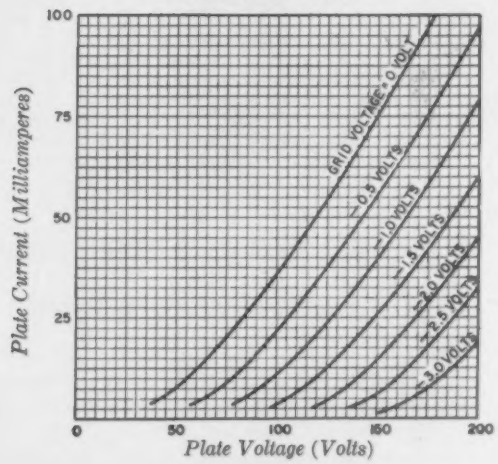
ELECTRICAL

Heater voltage	6.3 volts
Heater current	300 mA

Direct Interelectrode Capacitances
(without external shield) (Grounded Grid)

Input (K to g + h)	9.0 μμf
Output (p to g + h)	1.8 μμf
Plate to cathode and heater	0.55 μμf
Transconductance	26,000 micromhos
Amplification factor	43

Plate Characteristics



Maximum Ratings, Absolute Values

Heater voltage (ac or dc)	6.3 ± 10% volts max
Heater to cathode voltage	55 volts max
Plate voltage	200 volts max
Cathode current	38 mA max
Plate dissipation	4.5 watts max
Bulb temperature	160°C max

Typical Operation

Plate voltage	150	130 volts
Grid voltage	0	9 volts
Plate current	25	27 mA
Cathode bias resistance	60	360 ohms
Plate resistance	1700	1600 ohms
Transconductance	25,000	27,000 micromhos
Amplification factor	43	43

This reference sheet is one of a series from Rogers to keep you fully informed of electronic developments. A specially designed file folder for these bulletins is available from Rogers on request.

You are invited to make full use of Rogers Application Engineering Service at any time, on any problem. Just phone or drop us a line.

ROGERS
electronic tubes & components
A DIVISION OF PHILIPS ELECTRONICS INDUSTRIES LTD.
116 VANDERHOOF AVE., TORONTO 17, ONTARIO

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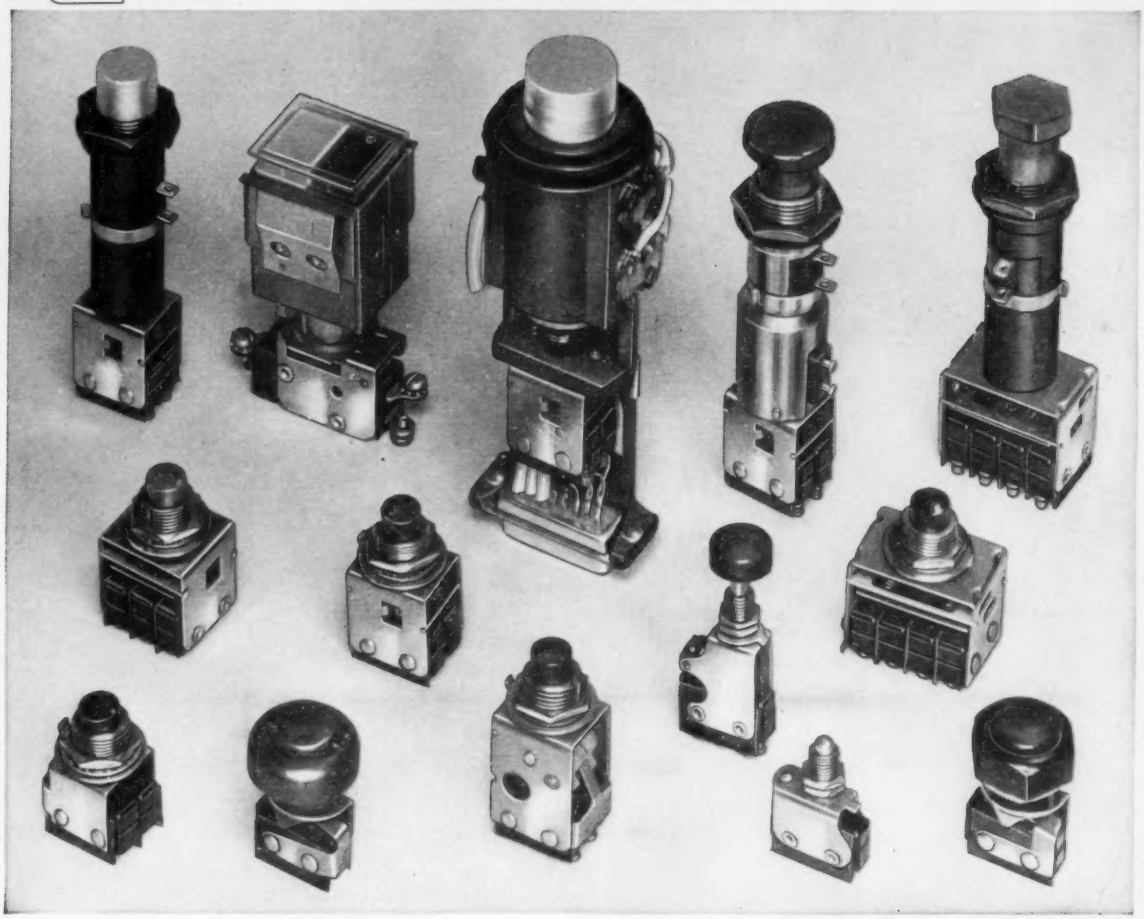
H HONEYWELL **MICRO SWITCH Precision Switches**



Need pushbutton switches?

Here is a sampling of a very wide choice

These assemblies are typical of many different series of MICRO SWITCH pushbutton switches. Each series offers many variations of electrical and operating characteristics.

Operational characteristics include: momentary action, lock-down, alternate action, two-position alternate action, and magnetically held. Direct control of up to fourteen double-throw circuits is offered. Short and long button strokes can be provided. Sealed switches are available when protection is required from oil, water, sand, or salt spray. Special shock and vibration-resistant features are built into switches for rugged duty service. Switches with illuminated pushbutton display are available. These include switch devices with interchangeable modular indicator and pushbutton units.

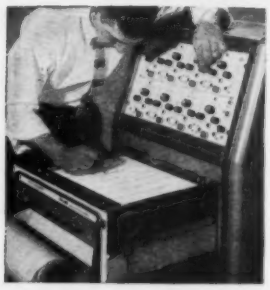
Experienced engineering assistance to help you select the pushbutton switch best suited to your requirements is as near as your nearest Honeywell office. Or write Honeywell Controls Limited, *Precision Components Division*, Toronto 17, Ont.

H HONEYWELL **Honeywell**

MICRO SWITCH Precision Switches

For further information mark No. 30 on Readers' Service Card

for direct writing recording systems no one is as qualified as Brush



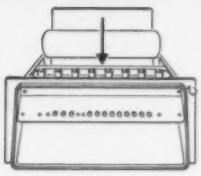
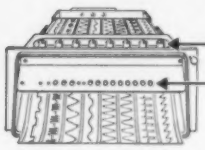
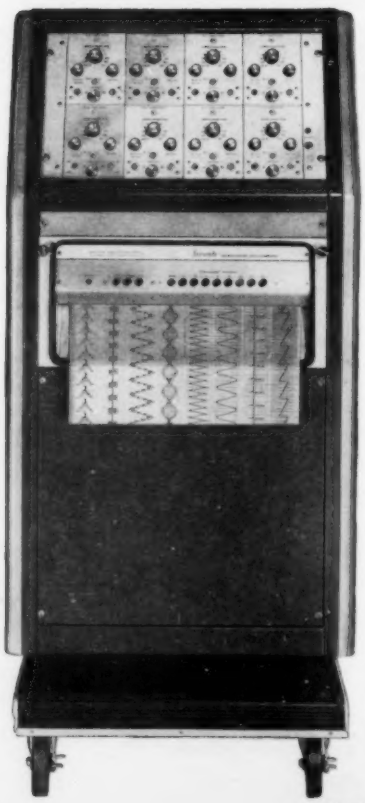


Chart paper loads from top



Trace contrast control

Simple pushbutton speed selection



Why? Simply because Brush recording systems such as this 6-8 channel unit incorporate all of the known refinements in the art of recording by direct writing. No comparable system in existence today is as compact . . . as simplified . . . as reliable . . . as versatile. Note slide-mounted oscillograph and interchangeable "plug-in" signal conditioners that provide four vital functions in addition to amplification: high input impedance, zero suppression, attenuation and calibration.

Instantaneous rectilinear presentation gives clear, uniform and reproducible traces for precise readout of telemetry, computer, ground control and other data gathering operations. Further, this functionally designed system has a "pull-out" horizontal writing table for convenient annotation and reading . . . without turning off the recorder! Check these and many other advanced features for yourself and you'll see why *no one* is as qualified as Brush. Call, write or wire for complete details.

In Canada: Bayly Engineering, Ltd., Ajax, Ontario

brush INSTRUMENTS

DIVISION OF CLEVITE CORPORATION

37TH AND PERKINS CLEVELAND 14, OHIO

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The Wide Wide World of General Electric Rectifiers

GERMANIUM LOW CURRENT

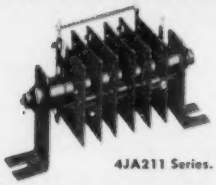
Series: 1N91-93 1N151-153, 1N158, 1N315 1N368

Series 1N91-93, 1N93—Alloyed-junction types combining very low forward resistance with high back resistance to give almost 100% efficiency. **1N151-153, 1N158**—Single- and two-fin versions of 1N91-93 series cells. **1N315**—Designed for high operating temp. (to 85°C.) and low reverse current. **1N368**—Features a very low reverse current at a high d-c reverse voltage. For magnetic-amplifier applications.

GERMANIUM MEDIUM CURRENT

4JA3011 Series: For general-purpose power supplies, control devices, blocking circuits, and many other applications. Extremely low power dissipation and forward voltage drop provide excellent regulation and efficiency. Available in stacks up to 12 fins, providing ratings in thousands of watts, depending upon the circuit design, with operation to 85°C. Also, available in single-fin mounting. Transient PIV's up to 600 volts per cell.

GERMANIUM STACKS



4JA211 Series.

4JA211 Stacks: The industry's most widely-used semiconductor rectifier series. Hundreds of thousands in use. May be arranged in stacks up to 12 fins to produce more than 160 various circuit configurations. Small, lightweight, excellent regulation.

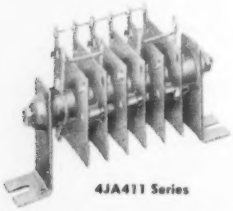
SILICON LOW CURRENT

Series: 1N536-540, 1N547, 1N560-561, 1N1095-1096, 1N440(B)-445(B), 1N1100-1103, 1N1487-1492, 1N599(A)-606(A), 1N1692-1695.

Series: 1N536-540, 1N547, 1N1095-96—Provide maximum forward conductance at high operating temperatures (165°C.). **1N440-445, 1N440B-445B**—Similar to 1N536-540 series, but with extremely low reverse current. Ideal for magnetic-amplifier applications. **1N1100-1103**—Similar to 1N440B-445B series. **1N1487-1492**—Essentially the same as 1N536-540 series, except provides lower-cost units for lower-temperature requirements (140°C.). **1N599-606, 1N599A-606A**—Similar to 1N-536-540 and 1N440B-445B series, respectively, except for somewhat lower forward-current ratings. **1N1692-1695**—Provides lower current and temperature operation (115°C.) than any of above series—very economical.

Series:
1N1115-1120,
1N253-256,
1N550-555,
1N332-349,
1N607(A)-614(A).
1N562-563

Series: 1N1115-1120—Available for stud mounting direct to chassis, or finned. Similar, in characteristics, to 1N536-540 lead-mounted series. Provide maximum forward conductance at high operating temperatures. **1N253-256**—High power-handling ability. Primarily for power supply and magnetic-amplifier applications. Type 1N256 meets JAN spec. **1N550-555**—Similar to 1N440B series, except for stud mounting. Extremely low reverse current, particularly suited for magnetic-amplifier applications. **1N332-349**—Industry-popular series. For applications requiring high reliability at moderate currents operating up to 170° C. **1N607-614, 1N607A-614A**—Another widely-used industrial line. Ideal for applications requiring high currents at up to 150°C.

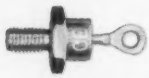


4JA411 Series

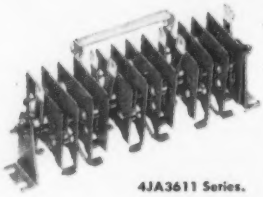
4JA411 Stacks: Combine high temperature operation (up to 150°C.) with increased ratings (up to 18 amps d-c). Hundreds of stack combinations to meet a variety of circuit conditions. High efficiency plus excellent regulation.

SILICON MEDIUM CURRENT

Series: 1N2154-2160



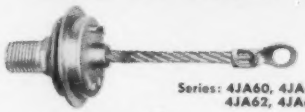
1N2154-2160 Series: First series of silicon medium current rectifiers to be made free from thermal fatigue. Designed for individual cell applications in the 2-to-25 amp range. High junction-temperature ratings. Extremely low forward voltage drop and thermal impedance. May be mounted directly, or electrically insulated from heat sink with mica-washer mounting kit provided with each unit.



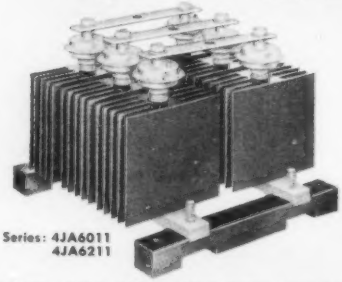
4JA3611 Series.

4JA3611 Stacks: Provide a wide-range of power applications with d-c outputs up to 65 amps.

SILICON HIGH CURRENT



Series: 4JA60, 4JA61, 4JA62, 4JA63



Series: 4JA6011 4JA6211

4JA60, 4JA61, 4JA62, 4JA63 Series: Large-area junction stud-mounted rectifiers. Operating temperatures to 200°C. D-c outputs as high as 85 amps per rectifying element. Lower-cost 4JA62, 4JA63 units are for applications which do not require the full-current ratings of 4JA60 line. Reverse polarities provided in 4JA61 and 4JA63 units. **4JA6011, 4JA6211 Stacks:** Hundreds of combinations available in various circuit configurations. D-c outputs up to 573 amps. The 4JA6211 series for lower-current, lower-cost operation.

SILICON CONTROLLED RECTIFIER

Series: C35 C36

CONTROLLED RECTIFIER RATING CHART

G-E Type No.	PIV* and V_{BO}	Max. I_{DC} at Temp. °C.	Max. Temp. °C. Oper.	Max. Temp. °C. Storage	Max. Reg'd Gate Signal
C35U	25	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35F	50	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35A	100	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35G	150	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35B	200	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35H	250	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35C	300	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.
C35D	400	Up to 16A at 87°C. stud	125	150	3V, 40ma at 25°C.

*Max. PIV and Min. V_{BO}.

C35 Series: Revolutionary silicon control device introduced by General Electric. Can do jobs of thyratrons, ignitrons, magnetic amplifiers, power transistors, relays, switches, contactors, circuit breakers, in many power-control and power-switching applications. **Medium-current C35 series** provides blocking voltages to 400V and load currents to 16 amperes. **Low-temperature,** lower-cost **C36 series** also available. Provides blocking voltages to 400V and load currents to 10 amperes. **High-current,** developmental-type **ZJ30 series** is now available on a prototype-sample basis.

FOR ADDITIONAL INFORMATION on G-E Semiconductors, or the name of your nearest G-E authorized distributor, write or contact Canadian General Electric, 189 Dufferin Street, Toronto.

SEMICONDUCTOR RECTIFIERS

1743-459

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

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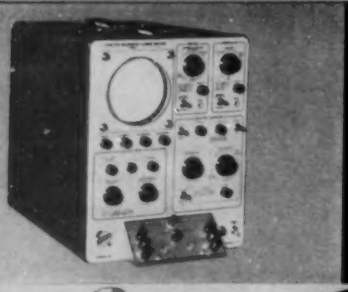
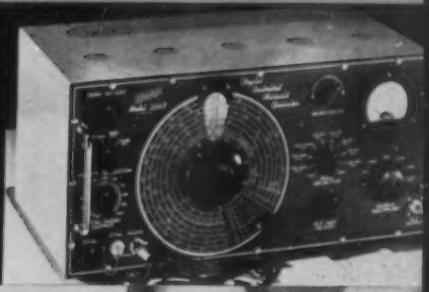
Here's an excellent opportunity to sell more!

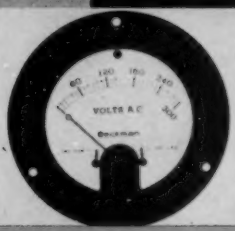
CANADIAN ELECTRONICS ENGINEERING'S MARCH

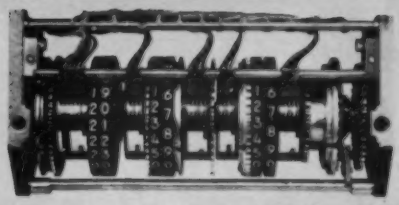
NEW PRODUCTS REVIEW



featuring a special report on Oscilloscopes and Signal Generators







The NEW PRODUCTS REVIEW will highlight the latest in

COMPONENTS • INSTRUMENTS • EQUIPMENT • OTHER PRODUCTS

An important part of the review will be reports on the latest developments in oscilloscopes and signal generators. These will include comparative tables of performance specifications.

Everybody in electronics is interested in "What's new?" —a fact which assures the March NEW PRODUCTS REVIEW of unusual reader attention. In turn, this higher readership makes the March issue one of the year's best advertising buys.

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CANADIAN ELECTRONICS ENGINEERING

ABSOLUTE MAXIMUM RATINGS AT 25°C

Forward Current	I_f	50 mA
Minimum Breakover Voltage	V_{bo}	TSW-30 30V TSW-60 60V
Reverse Breakdown Voltage	V_r	TSW-30 30V TSW-60 60V
Storage Temperature		−65°C to 150°C
Ambient Temperature Range		−55°C to +125°C

SPECIFICATIONS AND TYPICAL CHARACTERISTICS

(At 25°C Unless Otherwise Stated)

		Typical	Max.		Test Conditions
Saturation Voltage	V_s	1.0	1.5	Volts	$I_C = 50$ mA
Forward Leakage Current	I_F	0.1	10	μA	$V_C = 30V$
Reverse Leakage Current	I_R	0.1	10	μA	$V_C = -30V$
Forward Leakage Current	I_F	20.	50.	μA	at 125°C
Reverse Leakage Current	I_R	20.	50.	μA	at 125°C
Gate Voltage to Switch "ON"	V_g On	0.7	1.0	Volts	$R_L = 1K$
Gate Current to Switch "ON"	I_g On	0.1	1.0	mA	$R_L = 1K$
Gate Voltage to Switch "OFF"	V_g Off	1.2	4.0	Volts	$I_C = 50$ mA
Gate Current to Switch "OFF"	I_g Off	7.0	10.	mA	$I_C = 50$ mA
Holding Current	I_H	2.0	5.0	mA	$R_L = 1K$

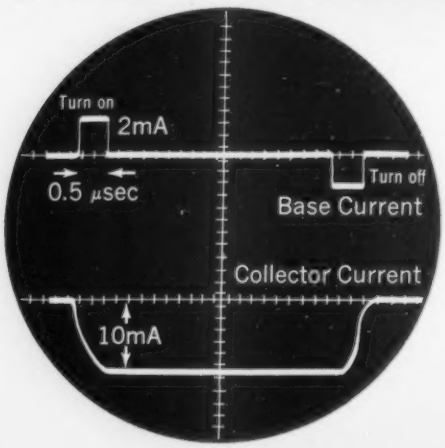
SPECIALLY DESIGNED FOR:

- Miniaturized Memory Circuits
- Ring Counters
- Shift Registers
- Controlled Rectifier Driver
- Flip-Flop Equivalent
- Simplified Information Storage
- 0.3 m second Switching

Transitron

announces a NEW computer element for: Greater Reliability • Circuit Simplicity

THE TRANSWITCH



The TRANSWITCH is a new bistable silicon device that can be TURNED OFF with gate current.

This PNPN latching device "remembers" its last gate signal. High current gain, both turn-on and turn-off, leads to greater circuit simplicity and inherent reliability. Excellent linearity of electrical parameters over a wide current range fulfills both low logic level and medium power needs.

Here is a unique device that replaces TWO transistors plus resistors in most bistable circuits and permits increased component density.

Furthermore, the transwitch is FAST . . . requiring only 0.3 microseconds to turn ON or OFF!

The TRANSWITCH is now available from TRANSITRON in the popular JEDEC TO-5 package, ready to solve your switch-on-switch-off requirements.

For further information, write for Bulletin TE-1357A

Transitron

electronic corporation • wakefield, massachusetts

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LOW LEVEL INPUT AMPLIFICATION

- *1,000,000:1 rejection ratio at 60 cps*
- *floating input*
- *isolated output*

IN 2 NEW SANBORN CHOPPER AMPLIFIERS

INDIVIDUAL SET-UPS

portable, self-contained unit amplifier

The Model 350-1500 Low Level Amplifier provides extremely versatile measurement of low level signals through use of two interchangeable plug-in circuits — one for thermocouple applications, another for DC strain gage work (other plug-ins now in development). Floating input and isolated output make the 350-1500 useful when signal measurements are made in the presence of large ground loop voltages. The 10-1/2" high x 4-3/16" wide 350-1500 may be used individually with its own power supply to drive a 'scope, meter, optical element, etc. or as a preamplifier in 6- or 8-channel 350 series recording systems.

MULTI-CHANNEL INSTALLATIONS

8-unit 7" high modules for "850" series direct writers

Compact Model 850-1500A Low Level Preamplifiers are economical, space-saving units for large installations such as aircraft and missile development and test facilities where many recording channels are used to monitor strain gage and thermocouple outputs. Required 440 cps chopper drive voltages can be supplied for up to 16 channels with the *Model 850-1900 MOPA.*

SPECIFICATIONS

	350-1500	850-1500A
Sensitivity	20 uv input for 1 volt output, or 10 chart div. with Sanborn recorder; X1 to X2000 attenuator	100 uv input for 1 volt output, or 10 chart div. with Sanborn recorder; X1 to X200 attenuator
Input	Floating, can be grounded	
Input Impedance	100,000 ohms	200,000 ohms
Output	Floating or grounded (independent of input)	
Output Impedance	350 ohms	
Output Capabilities	±2.5 volts across 1000 ohm load	
Bandwidth	DC – 100 cps (3db)	
Linearity	±0.1% of full scale	
Common Mode Performance	120 db for 60 cps and 160 db for DC with 5000 ohms unbalance in source	
Noise	2 uv peak-to-peak over a 0 to 100 cps bandwidth	
Drift	±2 uv for 24 hours	
Gain Stability	±0.1% for 24 hours	

(specifications subject to change without notice)

Complete specifications and application data are available from Sanborn Sales-Engineering Representatives in principal cities throughout the United States, Canada, and foreign countries.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 Wyman Street, Waltham 54, Mass.

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the monthly magazine which has received such enthusiastic support since its introduction by Lenkurt Electric in 1952

KEEP YOU UP TO DATE

as it has thousands of others in both Canada and the U.S.A. with timely and important articles

ON CARRIER COMMUNICATIONS

and developments connected with this field. For example, articles have appeared on: Factors affecting the propagation of Micro-waves; Transmission of Dial and Teletypewriter signals; Cable Transmission characteristics; Amplitude modulation, etc., etc. It is circulated

FREE OF CHARGE

to everyone on the mailing list. A limited supply of back copies are also available. Handsome binders to hold 12 copies are mailed annually with the January issue. Check your requirements on the coupon and mail it today

Reprint Book Available

The 32 most-requested articles from the first seven years of The Lenkurt Demodulator have been compiled into book form. The attractive, cloth-bound book is titled CARRIER AND RADIO ARTICLES SELECTED FROM THE LENKURT DEMODULATOR, and costs $2.50, post-paid.

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GENERAL TELEPHONE & ELECTRONICS

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Production sharing—a selective effort is needed

The Hon. Raymond O'Hurley, Minister of Defence Production, recently wrote to over 300 Canadian companies concerning the United States-Canadian Production Sharing Program. His letter reviewed progress during 1959 and pointed out what must be done to increase Canadian participation in the program.

One of his main points was that concrete successes in the past year have proved that concentrated and intensified sales efforts can and do result in substantial defense contracts. These experiences point up the need for a selective effort on the part of each interested Canadian firm, to whom the following suggestions were made:

a) Review carefully your own corporate plans and policies to determine the real extent of your interest in participation in this program.

b) Realistically assess your capabilities, determining what products you can sell competitively in the U. S. market rather than what you would like to sell if ideal conditions existed. Obviously, any special capabilities should greatly influence the selection of those products to be made subject of a sales effort.

c) Make a real effort to become familiar with opportunities within the United States for participation in the fields selected in accordance with b) above. Here, a good commercial intelligence effort with the aid of DDP officials and appropriate trade periodicals can provide a remarkably effective market analysis for any firm at a reasonable cost.

d) Arrange directly — through DDP on classified projects and elsewhere as required — to visit the selected U. S. buying sources to sell the capability direct. This direct buyer-seller relationship is absolutely essential, particularly in the early stages of contact.

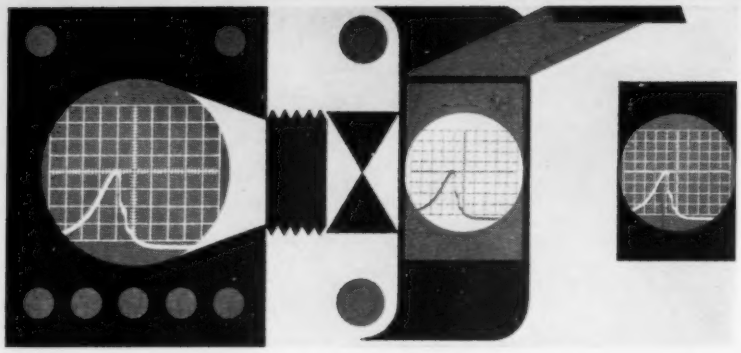
e) If and when Requests for Proposal are received, make a real effort to submit a clear, complete, and concise proposal that is competitive in every sense, bearing in mind that the technical merits of a proposal are a primary consideration, and that the price negotiation stage will never be reached if the proposal is not superior in its technical approach to the task.

f) Consider carefully the value of individual or shared engineering sales representation in geographic areas of real interest in the United States. Indications are that effective representation of this nature may well be a profitable investment for many Canadian firms.

g) Monitor continuously and carefully the type and amount of effort being assigned to this program to ensure that its direction and extent is consistent with the needs and plans of the firm.

Although so much depends on the management of Canadian industry, the Production Sharing Staff of DDP are available to help in every way possible. They can be contacted at Room 1215, No. 2 Temporary Bldg., 70 Lyon Street, Ottawa — Telephone Government local 6-6969.

THE EDITOR



New photographic films and techniques aid CRO trace recording

The oscilloscope has become such an important instrument in the laboratory and elsewhere that several new cameras, films and techniques have been introduced to facilitate recording information from the oscilloscope face. This article is a comprehensive report on Polaroid Land techniques, including details of the latest cameras and films

KEMON P. TASCHIOGLOU * & H. P. MANSBERG †

The need for permanent records of oscilloscope traces has become increasingly important as instrumentation and experimental techniques become more complex and costly.

Photography has long been used as a means of obtaining these records, but until a few years ago, this was an expensive and time-consuming proposition because of the darkroom work, processing facilities and technical know-how that were required to capture even relatively low-frequency steady-state phenomena on film.

In 1948, these obstacles were greatly overcome by the introduction of the Polaroid Land photographic process. Without setting foot inside a darkroom, the engineer or technician has a permanent record of the cro trace one minute after snapping the shutter of his oscilloscope camera.

The picture-in-a-minute technique not only saves time, it also eliminates the photographic know-how formerly required to secure a properly exposed picture of a cro trace. Getting each print on the spot, the engineer can run two or three trial-and-error tests until he finds the best exposure for the problem at hand.

These two advantages — speed and simplicity — soon sky-rocketed the one-minute picture technique into the most commonly used system for recording cro traces.

At one time, the process was used mainly to record low-frequency steady-state patterns in the laboratory as an aid to circuit development. But, with the development of more versatile cameras and faster films, cro traces that were formerly considered impractical or impossible to record are being photographed by engineers and technicians who literally know little-or-nothing about photography.

One of the most recent improvements in this field was the introduction of Polaroid's new 3000-speed film — a film so fast it can record single cro transients with rise times of less than one millimicrosecond.

Designated Type 47, the new film has a maximum writing rate 10 times higher than the fastest picture-in-a-minute film previously available for cro work. It will record transients of such high speed that they are invisible to the eye, and permits greatly improved photographs of steady-state patterns.

Four films — 24 cameras

While there are only four 60-second films available for cro trace recording, there are 24 models of specialized oscilloscope cameras that utilize Polaroid Land Camera backs — an indication of how important on-the-spot photography has become to the field of oscillography.

Table 1 lists the four films and describes the specific characteristics that make each one suitable for particular applications.

The films are made from one of two basic materials: paper, which produces opaque positive pictures (Type 42 and 47 film) and transparent film, which produces slides for projection (Type 46 and 46-L film).

The prints are developed in the Polaroid Land camera back in 60 seconds. After development, they require a plastic coating, provided by a print coater packaged with each film roll, for permanent protection. Both types 42 and 47 film produce 3¼ x 4¼-inch pictures.

The transparencies are developed for two minutes in the camera back, and require a 20-second bath in an emulsion-hardening solution which is contained in a hand-held tank (called a "Dippit") sold with the film. The

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† Airborne Instruments Laboratory, Mineola, Long Island.

TABLE I: Polaroid Land films and their characteristics for cro trace recording

Polaroid Land film type No. →	42	46	46-L	47
Base stock	Paper print	Positive transparency	Positive transparency	Paper print
Description	Panchromatic, wide range, medium contrast, ASA (daylight) equivalent exposure index 200, 8 exposures per roll.	Panchromatic, wide range, medium contrast, ASA (daylight) equivalent exposure index 600, 8 exposure roll.	Panchromatic, wide range, medium contrast, ASA (daylight) equivalent exposure index 600, 8 exposure roll.	Panchromatic, medium contrast, ASA (daylight) equivalent exposure index 3000, 8 exposures per roll.
Picture size (inches)	3¼ x 4¼	2¼ x 2¼	3¼ x 4 (lantern slides)	3¼ x 4¼
Oscilloscope trace recording application	Stationary traces.	Slides for projection, recording fine detail in complex waveforms simultaneous recording of slow and fast moving trace portions.	Slides for projection, recording fine detail in complex waveforms simultaneous recording of slow and fast moving trace portions.	High speed transients and stationary traces.
Remarks	Most economical of all films, but limited to steady-state trace recording.	Originals for diazotype reproduction in reports. Can be easily enlarged by conventional photography. Camera mirror inversion easily corrected by turning transparency over.	Originals for diazotype reproduction in reports. Can be easily enlarged by conventional photography. Camera mirror inversion easily corrected by turning transparency over.	Fastest photographic material for cro trace recording.

slides are then placed in plastic snap-together mounts for projection. (Type 46 Land Projection Film produces 2¼-inch-square slides for use in a special Polaroid Projector, and Type 46-L produces 3¼ x 4¼-inch slides for use in standard lantern-slide projectors.)

All four film types are panchromatic, so they can be used on all phosphors emitting light in the visible light range. There are eight exposures to a roll.

Type 42 is the most economical of the picture-in-a-minute materials, and its high resolution produces sharp records of complex waveforms or intensity-modulated traces. But, because of its relatively low maximum writing rate (a film's ability to record the fastest possible transients), it is largely used for recording stationary traces.

The 3000-speed Type 47 film is the most versatile Polaroid Land film available for cro trace recording. Its tremendous speed and extremely high maximum writing rate permit photographs of high-speed transients using shorter exposures, lower intensity cro settings and smaller lens apertures, resulting in sharper pictures containing more information than ever before possible.

The 24 oscilloscope cameras that use Land Camera backs are listed in Table 2, along with the names of the manufacturers and the general features of each camera model.

The cameras mount directly onto the standard cro 5-inch tube face by means of a flange or bezel which can be easily attached to the cro panel. They are designed to solve the problems of low light level, close-up photography imposed by the crt trace, and provide accurate centering, focusing and control of stray light, using one of three methods for positioning the camera-back and viewing-system in front of the crt.

In the first method, the film plane is perpendicular to the tube face. The cameras have a beam splitter mirror to permit direct head-on viewing. However, the mirror reverses the image on the film, and in some cases it separates the highly actinic blue light from the yellow portions of light energy emitted by the crt. Only a negligible amount of actinic light is lost by sending some energy through the beam splitter to the observer.

The second method places the film plane parallel to the tube face, with the viewing system at a slight angle to the tube face. The major advantage of this method is that the picture is correctly oriented — there is no image reversal. However, view at an angle causes slight distortion.

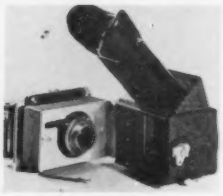
The third method — and undoubtedly the best for viewing purposes — has the film plane parallel to the tube face, with a swinging assembly so the camera back may be swung away from the crt face. Several cameras using this method employ a travelling wave crt designed specifically to display transients and repetitive phenomena in the millimicrosecond region. One camera, Beattie Coleman's Model 12365, has binocular angle viewing with the camera back swung into place, and direct head-on viewing when the camera back is swung away from the crt.

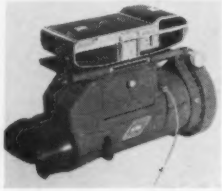
Some cameras employ an optical reduction system so the image is reduced by a factor of two. The primary advantages of this system are economical film usage (more images can be recorded per frame) and a gain in trace brightness reaching the film for a given exposure. However, those cameras with no reduction (one-to-one ratio) make direct calibration on the picture much easier.

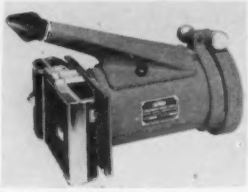
Camera backs are mounted with either the crt's horizontal or vertical axis parallel to the long film dimension. Horizontal mounting permits recording full width trace images from the 5-inch crt. Vertical mounting is usually combined with an optical reduction system.

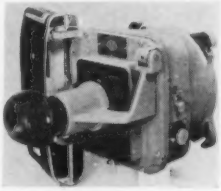
TABLE II: Oscilloscope record cameras with Polaroid Land camera backs —

MANUFACTURER	Beattie-Coleman, Inc., 1000 North Olive St., Anaheim, California	Allen B. Du Mont Laboratories Inc., 760 Bloomfield Ave., Clifton, New Jersey	Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston 15, Mass.
Canadian Representative	Alex L. Clark Ltd., 3745 Bloor St. West, Toronto 18, Ont.	Bayly Engineering Ltd., Hunt St., Ajax, Ont.	Samuel C. Hooker (Canada) Ltd., 2425 Grand Blvd., Montreal, Que.
Model No.	(a) 12445 (b) 12365	(c) 302 (f/2.8) (d) 302 (f/1.9) (e) 353 (f/2.8) (f) 353 (f/1.9)	(g) 710 with Type CA-3 Polaroid Adaptor





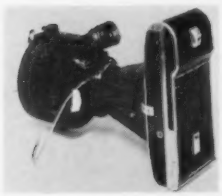




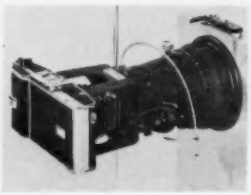
Model (a) 12445 ▼	(b) 12365 ▼	(c) 302 (f/2.8) (d) 302 (f/1.9) ▼	(e) 353 (f/2.8) (f) 353 (f/1.9) ▼	(g) 710 with Type CA-3 Polaroid Adaptor ▼
Lens Wollensak Raptar 75 mm., f/1.9	Wollensak Raptar 75 mm., f/1.9	(c) Wollensak Raptar 75 mm., f/2.8 (d) Wollensak Raptar 75 mm., f/1.5	(e) Wollensak Raptar 75 mm., f/2.8 (f) Wollensak Raptar 75 mm., f/1.9	Effective f/0.7
Shutter Alphax #3, 1 sec to 1/100 sec., time and bulb.	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	(c) Alphax #2, 1/25 to 1/100 sec. and bulb. (d) Alphax #3, 1 sec. to 1/100 sec. and bulb.	(e) Alphax #2, 1/25 to 1/100 sec. and bulb. (f) Alphax #3, 1 sec. to 1/100 sec. and bulb.	Manual movement of dark slide
Camera Back Position Above line of view, perpendicular to CRT	Parallel to CRT, with swing away assembly	(cd) Above line of view, perpendicular to CRT	(ef) Parallel to CRT	Parallel to CRT, with swing away assembly
Orientation of film's long dimension Parallel to CRT Horizontal axis	Parallel to CRT Horizontal axis	(cd) Parallel to CRT Vertical axis	(ef) Camera can be rotated 90° for recording on both axes of film	Parallel to CRT Vertical axis
Method of Viewing Binocular, dichroic mirror	Binocular, direct view	(cd) Binoculars, dichroic mirror	(ef) Monocular, direct view peep hole	Separate Monocular Camera must be swung out of position Enlarging viewing lens provided.
Image Orientation Inverted	Normal	(cd) Inverted	(ef) Normal	Normal
Reduction ratio 1:1	1:1	(cd) 2:25:1	(ef) 1:1	1:1
Mul iple exposures Sliding back with either 3 or 10 equally spaced exposures	Sliding back with either 3 or 10 equally spaced exposures	(cd) Sliding back with 3 position detent & scale markings for 9 exposures	(ef) Sliding back with 3 position detent & scale markings for 9 exposures	None
Other features Mounts on K-5 Periscope Assembly which takes other cameras as well.		Data card recording possible. Two full screen images can be recorded per frame. Accessories for mounting either types of camera backs and film available.	Minification adjustable to accommodate full 5-inch sweeps. Interchangeable camera back.	Designed for use with E. G. & G.'s travelling wave oscilloscope for recording extremely short pulses to 4 milli micro-seconds.

Manufacturers and characteristics

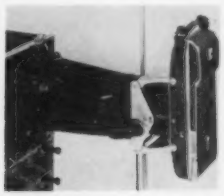
Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18 Pa.	Fairchild Camera and Instrument Corp., 5 Aerial Way, Syosset, L.I., N.Y.	Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, Calif.	Telechrome Mfg. Corp., 28 Ranick Drive, Amityville, N.Y.
Electromechanical Products, Markham Road, Agincourt, Ont.	Conway Electronic Enterprises Reg'd, 1514 Eglinton Ave. W., Toronto 10, Ont.	Atlas Instrument Corp. Ltd., 50 Wingold Ave., Toronto 19, Ont.	
(h) SM-200	(i) F-296 (j) F-286	(k) 196-A	(l) 1521-A



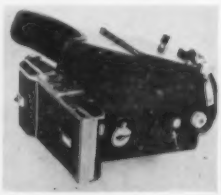
(h) SM-200



(i) F-296



(j) F-286



(k) 196-A

(l) 1521-A

▼	▼	▼	▼	▼
Wollensak Raptar f/1.9, 75 mm.	Wollensak Raptar f/1.9, 75 mm.	Wollensak Raptar f/1.9, 75 mm.	Wollensak Oscillo-Raptar f/1.9, 75 mm.	Wollensak Oscillo-Anastigmat f/1.9, 75 mm.
Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Alphax #3, 1 sec. to 1/100 sec., time and bulb.
Parallel to CRT	Parallel to CRT	Parallel to CRT	Parallel to CRT	Parallel to CRT
Parallel to CRT Vertical axis	Parallel to CRT Vertical axis	Parallel to CRT Vertical axis	Parallel to CRT Horizontal axis	Parallel to CRT Vertical axis
Monocular, direct view peep hole	Monocular, direct view peep hole	Monocular, direct view peep hole	Binocular, direct view	Monocular, direct view peep hole
Normal	Normal	Normal	Normal	Normal
1:1	1:1	2:1	1:0.9	1:1
None	None	Back can be positioned in two places.	Lens moveable to provide full width exposures	None
			Camera back rigid. Two 6CM x 10CM grid scales can be recorded on one frame. Focusing accessory kit is available.	

Table III: Cathode-ray tube phosphors and their characteristics for photo-recording with Polaroid Land films

Designation	P-1	P-2	P-5	P-7	P-11	P-15
Color— Initial fluorescnce	Green	Blue-Green	Blue-Violet	Blue-White	Blue	Blue-Green
Color— After glow	Green	Yellow-Green	Blue-Violet	Yellow	Blue	Blue-Green
Persistence	Medium	Long	Very Short	One Short — One Long	Short	Extremely short
Application	General purpose CRO work, repetitive or transient waveforms. Most frequently used on low voltage oscilloscopes.	General purpose higher accelerating potentials.	Display of high speed transients such as Radar A-Scope.	Similar to P-2, operates at lower accelerating potentials with longer persistence. Useful for radar, low speed transients, and integrating repetitive phenomena.	Photographic recording of transient phenomena. Has longer persistence than P-5.	Flying spot scanners, TV kinescope recording.
Use of filters	None.	Dark blue filter can eliminate long persistent yellow component for photography. Amber filter can eliminate initial blue-green flash. Remove for photo-recording.	None.	Blue filter can eliminate long persistent yellow component; necessary for long sweep periods. Amber filter can eliminate initial blue flash. Filters not usually used in photo-recording.	None.	None.
Comments regarding the use of Polaroid Land films	Relatively efficient for photographic recording of stationary or repetitive patterns. Brilliant output at low accelerating voltages.	Blue component is short persistent and has high photographic efficiency. Records successive transient phenomena, and low rate repetitive traces.	Relatively efficient for single frame recording. Not as high actinic output as P-11 phosphor.	Relatively high photographic efficiency for single frame recording. Not as efficient as P-2 phosphor.	Highest photographic efficiency makes it most useful for recording both transients and repetitive traces.	Not as high actinic output as P-11, but can be used effectively with Polaroid Land films for high resolution, high frequency recording.

Source: DuMont Industrial Cathode Ray Tubes, Industrial Tube Sales Department, DuMont Laboratories, Passaic, N.J.—1956.

Cro cameras are basically fixed-focus, but slight changes are provided for the positioning of camera parts to account for variations in the exact position of the crt face. These variations arise from different crt face configurations, different crt positions in the cro, and the position of filters and graticules.

Acurate focusing is important to recording details in a trace and, in general, cameras with a one-to-one reduction ratio require more precise focusing than those with a two-to-one ratio because of the decreased depth of field.

What affects exposure?

Although there are a tremendous number of variables in the camera-cro combination (and in the trace itself) that affect exposure, it is relatively simple to produce good pictures of stationary and transient wave forms with the Polaroid Land photographic process.

There is one major reason for this — speed.

Getting each picture a minute after shooting it, the engineer or technician can quickly determine the correct exposure by taking one or two trial shots, thus eliminating the need for complex exposure tables. The Polaroid Land films have a latitude wide enough so that a good picture may be obtained throughout a wide range of exposures.

Apart from circuitry and and design, every cro has two basic characteristics that determine its ability to produce a photographable trace: accelerating potential and tube phosphor. And, each trace has four major factors that have a marked effect upon exposure: intensity, spot size, spot speed and frequency and sweep repetition rates.

Let's take a look at each one in turn.

Accelerating Potential: A cro with a high accelerating potential produces a greater beam current than one with a low potential, and therefore has a larger actinic light output. This is particularly important when recording high speed transients. Wide band cro's in excess of 3 kv are usually needed both to see, as well as record, fast-moving transients.

Tube Phosphor: Table 3 describes the various tube phosphors, their use with filters, and their applications in photo recording. Although the P-11 is the best for photographic purposes, Polaroid Land films are recommended for recording with all of the commonly used crt phosphors (P-1, P-2, P-5, P-7, P-11 and P-15).

Because of their light output, some phosphors are better suited to photo recording than others (P-1 and P-2

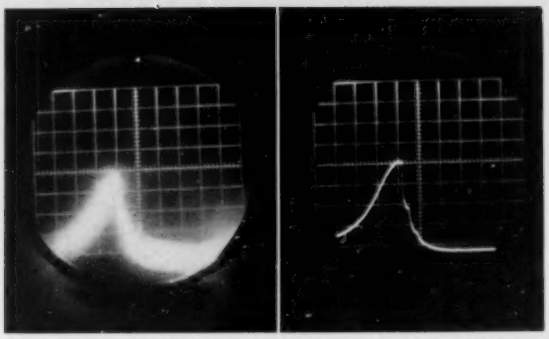


Fig. 1. The CRO's intensity control was set too high for picture at left. At right, the intensity was turned down and full detail is visible. Aperture was f/1.9 on both.

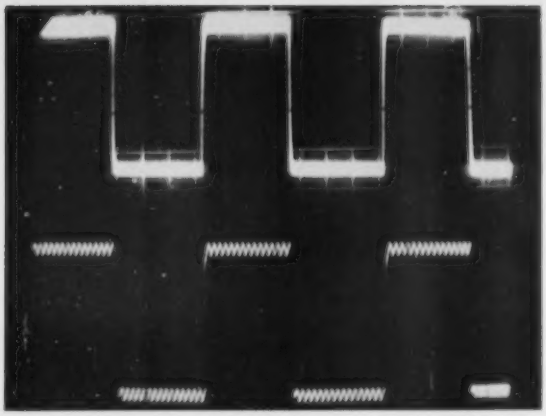


Fig. 2. Upper trace has been exposed to show rise time portion while losing detail on the flats. Exposure for lower trace was reduced to show detail in the flat tops.

are best for stationary traces; P-11 and P-15 for high-speed transients). Some have different color outputs in initial phosphorescence, and produce an afterglow which remains after the beam has passed. Amber, green and blue filters separate the initial fluoresence and afterglow to aid the observer in extended observations. The color and efficiency of each filter are important considerations in filter selection because they regulate the amount of light the filter will absorb, thus determining the amount of degradation in image quality it will produce from surface interreflection.

Intensity: A cro intensity setting controls the beam current and can have the greatest effect on proper exposure. Slight changes in intensity settings — almost unnoticeable to the eye—can have the same effect as a one or two "stop" change in camera settings (see Figure 1). However, the Polaroid Land films have such wide latitude that good exposures can be obtained throughout a broad range of intensity settings.

Spot Size: CRO's which produce smaller and more uniform spot size over the entire screen area are best for obtaining photographs with good resolution and detail. Those with high accelerating potentials generally produce smaller spot diameters, but at some sacrifice in the viewing area covered by the entire trace.

While the cro's focus and astigmatism controls are usually set for the best spot size and uniformity at any particular intensity setting, it is sometimes beneficial to deliberately misadjust the astigmatism controls in order to achieve optimum focus in one coordinate of spot motion. For example, to record a very fast rise time on a square wave pulse, the astigmatism control can be misadjusted to favor focus on the vertical position, sacrificing focus on the flat top portion.

Spot Speed: As the spot speed increases, more exposure or higher intensity settings are required to produce a good picture. This is especially important when recording non-repetitive traces and the faster portions of repetitive traces.

If a trace has peaks, the spot speed decreases near the peaks, and that portion of the trace which you are interested in recording should be considered in selecting the proper exposure. For example, in Figure 2, the flat top portion of the trace has been deliberately over-exposed in order to increase detail in the rise time portion.

Increasing the amplitude of either axis will increase the spot speed and lower the trace brightness. A trace four inches from peak to peak may require four times as much exposure as a trace which is one inch high.

Frequency and Sweep Repetition Rates: Changing the frequency or sweep repetition rate of a given signal af-

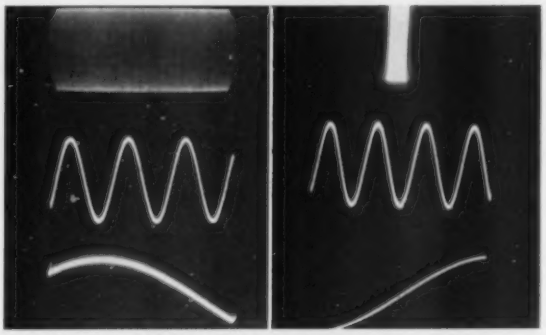


Fig. 3. (Left) Effect of increasing sweep repetition rate while holding intensity, x-gain and signal frequency constant is shown in these 30 kc traces indicating 16 cycles per inch, 1 cycle per inch and 1/16 cycle per inch. Fig. 4. (Right) This shows the same trace sequence as in fig. 3, but the x-gain was increased and sweep repetition rate, intensity and signal frequency held constant.

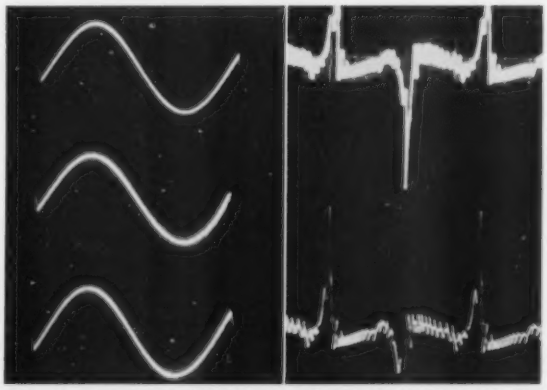


Fig. 5. (Left) Although the signal frequency of the traces was increased from 30 kc to 300 kc to 3 mc, there is no visible change in exposure because sweep repetition rate was maintained at ¼ cycle per inch on the CRT. X-gain was constant with camera at f/5.6 and 1/50 sec. Fig. 6. (Right) Top trace is overexposed and appears to bloom. Lower trace is slightly underexposed for fine detail. Intensity setting remained the same for both.

fects exposure—but not drastically, as long as a high-duty cycle sweep is used. In Figure 3, the intensity of the 30 kc trace was kept constant (as was x-gain and signal frequency), and the sweep repetition rate was increased from 16 cycles/inch to 1 cycle/inch to 1/16 cycle/inch on the screen. All three traces are readable, but they could have been improved by compensating changes in exposure. Figure 4 shows the effect of changing x-gain to compress the same pattern shown in Figure 3, while holding intensity, sweep repetition rate and signal frequency constant.

Increasing the signal frequency and changing the sweep repetition rate to produce the same number of cycles on the screen would have no effect on the exposure — again, as long as a high-duty cycle sweep was used. In Figure 5, there is no noticeable change in exposure of the 30 kc, 100 kc and 3 mc traces. (Intensity and x-gain were held constant.)

Occasionally, a high frequency signal has to be displayed on the cro with a very low-duty cycle sweep. Although this will render the signal practically invisible to the eye, the trace may be recorded with 3000-speed Type 47 film at maximum exposure.

Exposing for transient and steady-state traces

The exposure of a film is the product of the size of the opening through which the light passes (aperture, or f/number) and the length of time the shutter is open (shutter speed). When over-exposed (too much light has reached the film), a medium intensity trace appears to bloom, while an underexposed trace will have fine detail (see Figure 6). When the intensity setting is run up too high and visible blooming appears on the cro tube face,

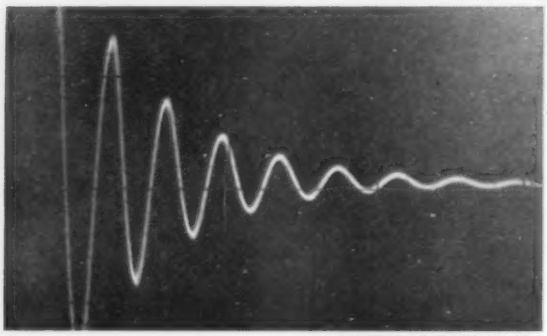


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Fig. 7. This shows how Type 47 film can record spot speeds up to 4,000 cm/usec. Measured at 450 mc, the single transient has a peak-to-peak amplitude of 2.4 cm.

it can be eliminated by under-exposing the picture (cutting down the amount of light that reaches the film).

Aperture and shutter speed may be adjusted independently to provide a broad range of exposure control over a tremendous number of variations in image intensities. Aperture settings have a marked effect upon depth of field, because the lower the f/number used (the larger the lens opening), the shallower the depth of field becomes, necessitating more precise focusing to eliminate optical distortion.

Aperture control is the only variant used in recording transients, because the shutter is usually held open (left on the "Bulb" or "Time" setting) to record one complete sweep. With a non-repetitive transient (whether controlled or random), there is no choice but to leave the shutter open until the transient occurs.

Generally, the spot is positioned on the left side of the screen, the camera shutter is held open on the "B" or "T" setting, the transient initiated, and the shutter closed. With cro's having automatic beam gate circuits, the intensity control is usually turned down so that the spot is invisible to avoid fogging the film while waiting for the transient to appear. When the transient is initiated, the beam is automatically gated, brightening the trace at the same time the sweep is triggered.

Any Polaroid Land film will record simple transients below the 100 kc range, but Type 47 film should be used

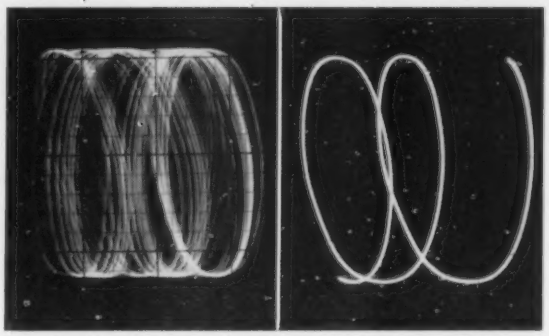


Fig. 8. An electronic beam gate built into a CRO can isolate one cycle of a continuously varying trace as shown at right. Blurred trace at left did not have a gate.

for higher speed transients because available light from the trace is at such a premium. The 3000-speed film's extremely high light sensitivity permits lower intensity settings and smaller apertures. This provides sharper focused pictures and eliminates the "blooming" caused by large spot size, and the blurring inherent in circuitry containing unavoidable drift and jitter.

In existing cameras and standard cro's — even those with the highest accelerating potentials — it is almost impossible to record transients with spot speeds of more than 2,000 cm./microsecond. However, Figure 7 shows that Type 47 film will record spot speeds up to 4,000 cm./microsecond under optimum conditions.

In recording steady-state patterns, the cro controls should be adjusted to provide the sharpest trace possible, and aperture settings should be kept small in order to increase depth of field, improve camera focus and reduce optical aberrations.

When using low sweep repetition rates, the shutter must remain open for at least the time of one sweep or an undesired blank space will occur in the recording. Even if the shutter is open slightly longer than the sweep duration, uneven exposure of the trace may result.

As a general rule, the exposure time for such traces should be 5-to-10 times the sweep duration in order to result in a uniform recording. However, time exposures should be kept to a minimum to reduce any fogging or blurring caused by drift or undesirable modulation.

In addition to signals requiring very low sweep repetition rates, precise selection of shutter speed becomes important in recording wave forms with slow modulation or jitter and continuously varying traces.

When using cro's with built-in beam gates, the driven sweep and external sync. controls permit triggering of the gate for one sweep of a continuously varying pattern without difficulty. However, when using instruments without built-in beam gates, it is necessary to adjust the shutter speed to the duration of one sweep. This can only be done if the sweep speed and rate of pattern change are relatively low.

In Figure 8, the first trace is blurred because several varying signals were recorded. The second trace was electronically gated to display only one trace for recording purposes.

TABLE IV: Polaroid Land films typical maximum writing rates*

Polaroid Land Film Type →	42	46, 46-L	47
ASA exposure index daylight (equivalent)	200	600	3000
Max. writing rate—normal (cm. per microsecond)	400	490	(over) 3500
Max. writing rate—prefogged (cm. per microsecond)	700	1000	(over) 8500
Prefogging exposure with 30 candles/ft.² illumination	1/100 sec. at f/8.	1/100 sec. at f/11.	1/100 sec. at f/16.

* Maximum writing rate measurements made on Tektronix 517A CRO, 24 kv accelerating potential. Displayed was single 450 mc damped sine wave transient. Camera reduction ratio 1:1 at f/1.9.

Maximum writing rate: what it is and how to improve it

A film's maximum writing rate is probably its most important characteristic with respect to its ability to record cro traces, especially transients. It specifies the maximum linear speed of the crt spot, in a single traverse, that can produce a barely readable record on a film for a particular combination of cro, camera and settings. The higher a film's maximum writing rate, the better suited it is for cro photo recording.

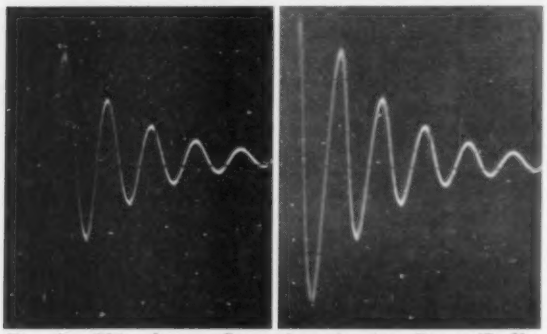


Fig. 9. This shows effect of prefogging Type 47 film to increase maximum writing rate. Treated film at right had double the effective speed of untreated film.

Maximum writing rate is, in a sense, analogous to the ASA exposure index which is used to indicate a film's sensitivity for recording daylight scenes. However, the two are not necessarily related. For example, the Type 47 picture-in-a-minute film has an ASA index of 3,000, but its maximum writing rate is more than 3,500 cm./microsecond.

ASA exposure indexes are determined from a film's response to daylight and tungsten light, both of which have spectra much different from that of any cro tube phosphor. In addition, exposure index is a measure of the exposure required to reach a particular contrast gradient in the film's characteristic curve, while readings for maximum writing rate are determined in the threshold region of the film's curve (the region of deepest black on a Polaroid Land print).

Unlike ASA exposure indexes, a film's maximum writing rate can be increased, pushing up its maximum sensitivity so the pictures often show invisible portions of a fast trace on any phosphor type at various accelerating potentials and cro settings.

The maximum writing rate of Polaroid Land films can be increased by any one of three methods:

Decreasing the Development Time: This method is especially effective when photographing high-speed transients, because developing the Polaroid Land prints for only 20-to-30 seconds instead of a full minute will just about double the film's maximum writing rate. (Optimum is 20 seconds.)

When the picture is removed from the camera back 20 seconds after pulling the paper tab to start the development process, the overall background is considerably lighter and contrast is lowered—but detail can be seen in parts of a fast trace that would not be visible with 45-to-60 seconds of development time. However, full 60-second development is recommended when details on faint portions of a trace are desired.

Prefogging: Controlled marginal exposure of a film to a light source before exposure to the trace will increase maximum writing rate two-to-three times. In fact, prefogging has been found to be the most effective single method for increasing maximum writing rates. It does not cause as sharp a drop in contrast as under-development, and it is not necessary to prefog so much as to lighten the background considerably.

A variety of different procedures can be used to prefog, but perhaps the most popular method is to point the camera at a 10 x 10-inch transparency viewer illuminated by a 15 watt bulb covered with three or four layers of tissue paper. The camera should be far enough away (a foot is sufficient) so that the texture of the tissue paper is out of focus, and yet close enough so the illuminator covers the entire field of view of the camera.

Another convenient method of prefogging is to point the camera at a light wall reflecting the proper brightness (30 candles/sq ft is a good guide). Figure 9 shows the effect prefogging has on the 3000-speed Type 47 film. In both traces, the camera and intensity settings remained the same.

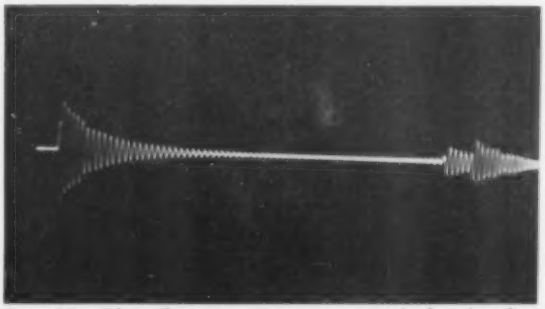


Fig. 10. This illustrates presence of cathode afterglow from an unaluminized phosphor. Shutter was held open for eight minutes while awaiting a random transient.

Maximum writing rate can be increased even further by combining the prefogging and under-development techniques. Using one of the prefogging methods described above, the picture is removed from the camera after 30-to-35 seconds (not 20 seconds) to keep the background dark enough to provide proper contrast.

Transillumination: This is the third method of increasing a Polaroid Land film's maximum writing rate, and simply involves the viewing of a print over a bright diffused light source (such as a 100 watt lamp) to make readable very dim parts of a trace.

Another method of accomplishing this is to glance at the negative still in the back of the camera after removing the positive print. Although it will fog rapidly under light, valuable information is often available.

Table 4 lists the maximum writing rates of all Polaroid Land films for normal development and prefogging, and contains an exposure guide for prefogging.

Fogging versus prefogging

While prefogging is the most effective method for increasing the maximum writing rate of a picture-in-a-minute film, fogging is one of the biggest headaches encountered in cro photo recording. It is caused by stray light striking the film at the same time that a trace is exposed, resulting in loss of contrast and optical distortion.

The most common source of fogging is from the crt itself. Blooming caused by high intensity traces or over-exposure can result in a glow from the entire crt face and excessive reflection from the walls of the camera tube. Control of this fogging is achieved by more careful adjustment of camera and cro intensity settings.

When recording transients, a stationary spot from a cro with no automatic beam blanketing circuit can also

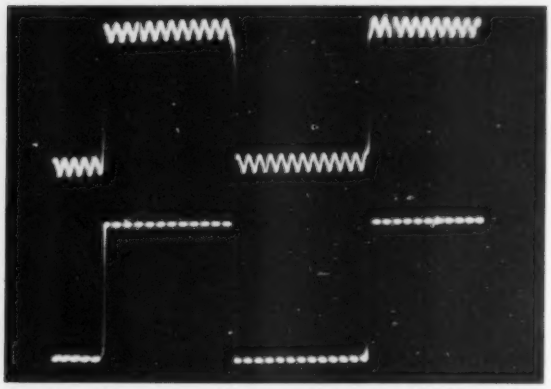


Fig. 11. Top trace shows vertical pips added for time calibration, while the lower trace has a Z-axis signal input modulating intensity for time calibration.

cause film fogging. To eliminate it, the spot should be positioned near, but not beyond, the edge of the screen side, and masked out with tape or black opaque paint. If the spot is moved too far off the screen to the side of the tube, the mask will not cut the glow from the electronic scattering.

Cathode glow and stray emission are two sources of fogging that come from internal parts of the crt. Cathode glow (see Figure 10) is caused by the infra-red glow of an incandescent cathode penetrating an unaluminized phosphor screen. It can cause serious fogging when the shutter is open for long periods of time, such as while waiting for the appearance of a random transient. This type of fogging does not occur on cameras which have backs perpendicular to the crt because the blue reflecting dichroic mirror does not reflect the infra-red glow. (A blue filter can help eliminate the glow when it is not practical to use higher accelerating potential cro's with aluminized screens.)

The stray emission caused by electron reflections from deflection plates on some older type oscilloscopes will show

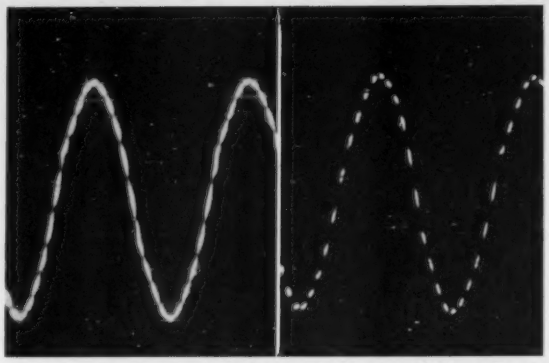


Fig. 12. Trace on left does not have sufficient Z-axis amplitude modulation. Trace on right has been improved by lowering intensity and increasing development time.

a slight glow on the crt. This can result in film fogging, but slight adjustments in the position of the electron beam or reduction in the deflection amplitude will usually eliminate it.

Occasionally, stray light leaking between the camera itself and the flange or bezel holding it against the cro tube face will result in fogging. As with cathode glow, this problem occurs when the shutter is held open for long periods of time. The only practical solution is to exercise more care in mounting the oscilloscope record camera.

Recording special effects

It is often useful to record markers, graticules and data charts on the same picture as a trace in order to simplify the trace calibration. These records are made by exposing both the trace and data at the same time, or by exposing the film with the extra information before or after recording the trace itself.

Calibrated markers for adding time information to a trace are either superimposed on the vertical axis of the trace or used to modulate its intensity (see Figure 11). If the intensity modulation signal is not sufficient to provide noticeable effects on the picture, it can be improved by reducing the cro intensity and increasing the contrast of the Polaroid Land print through increased development up to two or three minutes (see Figure 12).

Illuminated graticules can usually be recorded with the trace on a single exposure with 3000-speed Type 47 film by turning up the graticule scale brightness and lowering the crt intensity. With other less sensitive films, it is usually necessary to make two separate exposures — one for the graticule and one for the trace — especially when a P-11 phosphor is used. (This phosphor has a higher actinic light output with the intensity at medium setting than the graticule scale brightness usually has at full intensity.)

To make the two pictures, the graticule is recorded with its illumination turned up and crt intensity turned down. (Where there is a choice between white or colored graticule illumination, the white lines should be used.) Then, the graticule is turned off and the three records with cro intensity at the normal setting. The graticule should be kept in sharp focus (it is not in the same object plane as the trace) and apertures kept to a minimum.

Some oscilloscope record cameras are provided with a ground glass surface on which identifying data can be written with pencil. Internal illumination exposes this data on the film. However, some data cards require a second exposure, and in these instances, the trace intensity and graticule scale illumination should be turned down before exposing the data card to avoid double exposure of the trace.

END

Author Ratz checks print out of Data Logger console used to record operation of a four-generator power station.

Industrial process data reduction

Future systems will use electronic computer techniques for greater speed and flexibility

H. C. RATZ, P.ENG.*

Two recent installations of alarm scanning and data logging equipment in power generation plants are described as examples of current requirements. As the needs expand into larger and more complex fields, the application of the best electronic computer techniques is becoming economical. The addition of control capabilities will lead to complete process automation

The automatic centralization of operational data in process industries assumes greater importance as the size of the operations increases. The success of digital information processing machines in the computational and business fields has led to their application in the control of physical systems. Here the physical parameters are represented by analogous electrical signals which are quantized and encoded in digital form for processing to a typewriter or other output mechanism. An alarm scanner is usually combined with the digital recorder, and both functions involve periodic sampling of the continuous input signals. The amount of information processed is proportional to both the fineness of quantization and the sampling rate.

Such information systems are the precursors of complete plant automation, since data collection must precede control. Two automatic data reduction systems designed and built by Fischer and Porter (Canada) Ltd., and now operating in Western Canadian turbo-generator plants, are illustrative of contemporary data systems. These equipments are called upon to scan numerous temperatures, pressures, etc. (the "process variables") searching for alarm conditions and to periodically record the values on a log

*University of Saskatchewan, Saskatoon (formerly with Fischer & Porter (Canada) Ltd., Toronto).

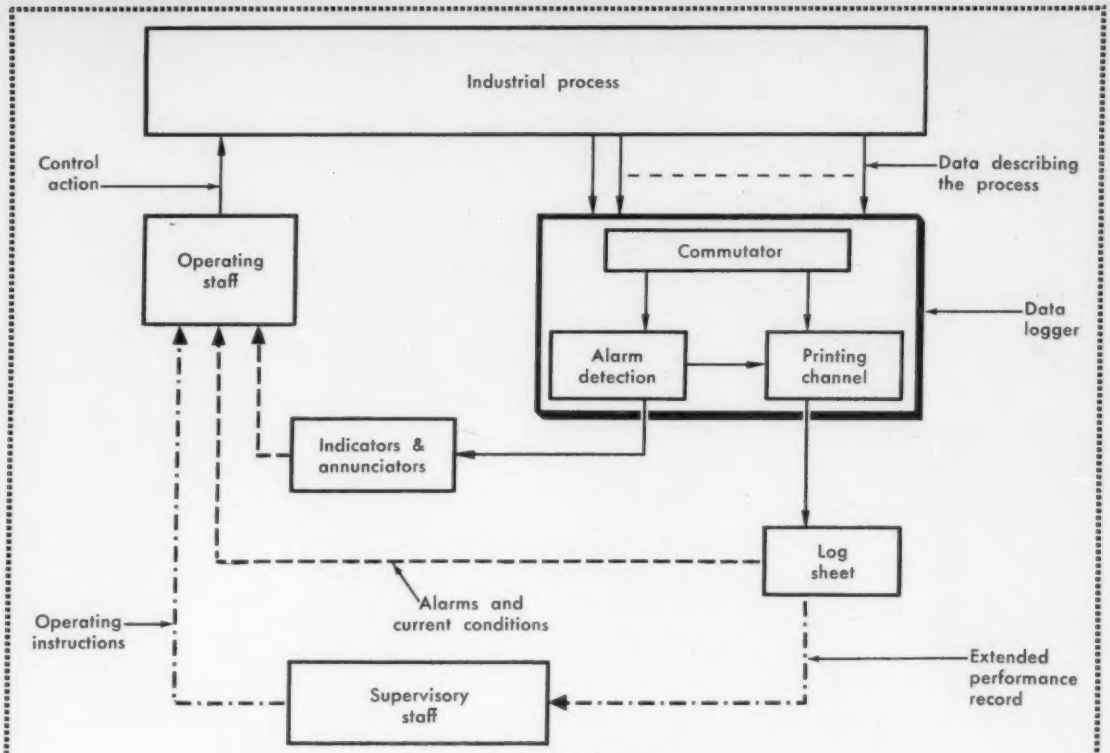


Fig. 1. Data reduction system.

sheet. These functions relieve trained personnel from the unproductive routine tasks of rechecking normal equipment and keeping records by hand. Not only is the requirement for numerous hand log sheets and recorder charts reduced, but the data is made available at the operator's location on a typewritten sheet and in direct reading units. For example, a 200-point Data Logger will produce periodic samples of process variables together with a complete record of alarms on a single log sheet and in a form which is readily assimilated. The use of separate graphic recorders would produce at least 200 charts showing all minute variations, but by providing too much detailed information in a form not readily digestible, would actually hinder its use.

Similar systems are applicable in pipeline transportation, chemical processing, power generation, etc., wherever supervisory control facilities exist. The amount of human participation is reduced leaving the operator to exercise his control function. Conventional instrumentation will still be required for localized maintenance and until more experience is gained with the possibilities and performance of the new techniques.

Basic system operation

The general concept of current Data Logger applications is shown in fig. 1. The data describing the process, or the "instrumentation," consists of analogue electrical signals from primary instruments, repeaters or transmitters, and in general may include any process quantity that has been reduced to electrical form. This includes the outputs of thermocouples, resistance thermometers, slidewire repeaters, current or voltage transmitters, etc. After sequential sampling by a commutator, the information is supplied to two channels: a scanning or alarm detection channel, and a logging or printing channel.

In the two examples to be described, the commutator is shared by both channels, although separate commutators may be required if the higher speed alarm scanning is not to be interrupted by print-outs. The alarm detection channel sequentially samples all process variables and searches for abnormal conditions by comparing each value with that of a preset alarm boundary. The discovery of an alarm activates indicators and annunciators, and results in a log sheet entry showing the time and conditions of the alarm. Process variables which are particularly pertinent to evaluating its performance are automatically logged at preselected intervals. Further, the operator may request printed entries manually at any time. The complete log sheet record provides the operating staff with a description of alarms and current conditions to be used as a basis for control action. Thus, from a short time point of view, the Data Logger alarm scanning and printing functions provide information in a feedback path in which the operator is the control link. This is indicated in the block diagram by broken lines.

The log sheets produced by the Data Logger form an extended permanent performance record of use to supervisory and engineering staff in formulating operating instructions. The record gives periodic samples of all process variables and gives an account of all alarms, showing when they occurred and when they returned to normal. By providing supervisory personnel with information to be judged against longer-term performance and efficiency criteria, the Data Logger forms part of the outer feedback control loop which includes instructions to the operating staff on control procedures. This longer-term loop is in-

dicated in the block diagram by chain-dotted lines. Its effectiveness will increase as management experience is acquired with data reduction equipment.

Chemainus, B.C.

The first example used here of a Data Logger installation is at the Georgia Generating Station of the British Columbia Power Commission, located at Bare Point, Chemainus, B.C. This plant has four fuel-oil-fired gas turbine generators, each producing approximately 20 megawatts. The Logger enters the signals from each generator unit on a separate line of a preprinted log sheet using one automatic electric typewriter. The number of units in use at any time is controlled by the operator who may bypass all points on shut-down units. The operator may request an immediate log on any individual unit; otherwise, all active units are printed automatically at preprogrammed intervals. In response to a new alarm, or to an alarmed point which has returned to normal, a print-out of all points on the generator unit concerned will ensue, with all out-of-bounds points and the unit number identified by red entries. The record includes readings of active and reactive power as well as temperatures from thermocouples and resistance thermometers. In this machine, alarm sensitivity is maintained during print-out, although a single commutator means that the rate of alarm scanning is slowed, when printing, to that of the typewriter.

The use of common scanning and printing channels for all four units provides a certain economy of equipment, since the chief addition for the extra units is for commutators. However, since the units must be treated serially, the response to alarms is four times as slow and the time required to enter all units on one log sheet four times as long as if separate Loggers were used operating in parallel.

Wabamun, Alta.

The second example of a Data Logger power plant installation is at the Wabamun Power Plant of Calgary Power Ltd., at Wabamun, Alberta. This plant has two gas-fired steam turbines each producing approximately 70

Table 1. Comparison of two Canadian Data Loggers

	Chemainus, B.C.	**Wabamun, Alta.**
Date installed	November, 1957	November, 1958
Total capacity	200 signals	250 signals
Capacity used	82 percent	82 percent
Inputs	Thermocouples (iron-constantan) Resistance thermometers Thermal converters (power)	Thermocouples (copper-constantan, chromel-alumel) Resistance slidewires Contact closures Electric current signals
Accuracy—measuring **—alarms**	± ½% f.s. ± 1%	± ½% f.s. ± 1%
Alarm system	Thermocouple discontinuity High alarm settings (6 settings cover 126 points)	Thermocouple discontinuity High and low alarm settings (46 settings cover 148 points)
Measuring instrument	L & N Speedomax "H"	L & N Speedomax "G"
Analogue-to-digital converter	Fischer & Porter Digi-Coder (electromechanical)	Giannini Datex Encoder (etched disc and brushes)
Ranges	As required to make direct reading within factors of 10 Digital range scaling	As required to make direct reading within factors of 10 Digital range scaling Digital zero offsets Analogue range attenuation
Output	One typewriter (Fischer & Porter–Underwood) Alarm indicators	Two typewriters (I.B.M.) Alarm indicators
Construction	Bench console containing all equipment and carrying typewriter	Two typewriter desks and remote relay cabinets for equipment
Application	Four 20-megawatt generators (General Electric)	Two 70-megawatt generators (Metropolitan-Vickers)
Log sheet format	Four-line print-out, one line per generator unit	One generator unit on each typewriter

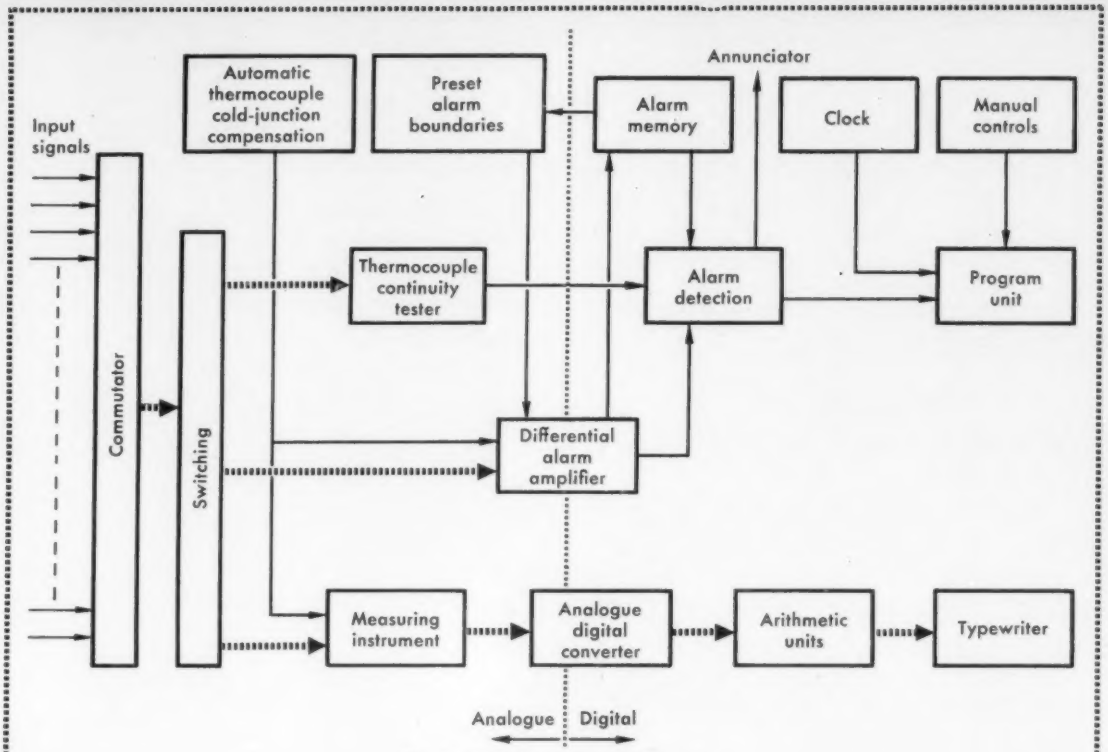


Fig. 2. Data Logger and Scanner.

number printed before the value. The color of this number indicates whether the entry was caused automatically by alarm detection or by manual demand. Such entries are made in a separate portion of the log sheet.

The record includes integrated gross generation and station service consumption computed by the Logger, from which it also derives the net generated power. The remaining points are chiefly thermocouples and Evershed and Vignoles current transmitters representing temperatures, pressures, flows, etc. In contrast with the Chemainus installation, these twin Loggers normally operate completely independently in parallel on two separate typewriters. However, advantage is taken of the duplicate equipment by permitting either plant Logger to be expanded to cover the process variables from both plants. In addition, identical subassemblies are interchangeable between the two machines. The changeover to serial operation can be made easily from the control room, but since the plants are treated sequentially, the time of response to alarms and the time required for a print-out are doubled. However, complete flexibility is maintained in the use of one or both typewriters under these conditions. Thus the redundancy in equipment is utilized to provide back-up when necessary as well as improving the accessibility of the data under normal conditions.

Operational details

Table 1 compares some of the features of the Chemainus and Wabamun Data Loggers. Both were designed and built in Canada and cost approximately 0.2% of the total plant costs. Although there is sufficient operational variety to require custom design for each installation, many models are generally described by the block diagram of fig. 2. The two examples mentioned above fit this scheme.

In these, sequential commutation is accomplished by electromechanical stepping switches and each input in turn may be switched to the alarm detection or measuring channels. The stepping switches also select the individual point alarm boundaries and perform other programming functions.

In the alarm detection channel, thermocouple cold-junction compensation is automatically provided and all thermocouples are checked for resistance to detect the open circuits that often occur in thermocouples subject to vibration. Each point is referred to its appropriate alarm boundaries and checked by an electronic differential amplifier. This high gain amplifier energizes a relay according to the relative magnitude of the signal and the manually preset high and low alarm set points. Its sensitivity is of the order of 20 microvolts. The alarm set points themselves are automatically readjusted to cover the dead band of the amplifier and provide system stability for signals near the set point. A capacitor memory system enables new alarms to be distinguished from continuous ones, and causes log sheet entries when points return to normal as well as when they go out of bounds. Provision is made for the operator to insert a simulated alarm in order to check the functioning of the alarm scanning channel. Lamp indicators on the Logger control panels show the existence of alarms and the occurrence of new ones.

In the printing channel, the thermocouples again have automatic cold-junction compensation. The measurement is made by a conventional self-balancing potentiometer and is encoded into digital form by a shaft position analogue-to-digital converter. A special null-balance detection circuit

Top: One of the Wabamun Data Logger typewriter desks, showing log sheet and remote control boxes.

Middle: The Chemainus equipment is completely housed in the console, with all controls on the top.

Bottom: Relay and stepping switch panels are mounted on hinged racks inside the doors for easy access.

is employed to permit "read-when-balanced" operation. The Leeds and Northrup "Speedomax" potentiometers may carry several slidewires, some being characterized to match the nonlinear thermocouple output curve. The digital arithmetic units then perform scale change, zero offset, code conversion and serialization of the data for typewriter operation. The measuring potentiometers are standardized hourly by comparison with standard cells.

A useful feature is the ability to demand a print-out in which the alarm boundary values appear in place of the signal values. This provides a log sheet record of the alarm settings as well as a cross check between the alarm detection and measuring channels.

Computer techniques

Future trends in automatic scanning and logging equipment will be toward higher scanning speeds and the use of the new solid state techniques of the electronic computer industry. Solid state commutators for small numbers of input signals are emerging from the experimental stage, and a high-speed transistorized analogue-to-digital converter is now available. The use of electronic computer techniques will be accompanied by an increase in cost; however, the economic balance may be restored somewhat as the installations increase in complexity and take advantage of the higher speeds and greater flexibility possible.

Experience with data reduction equipment by both the manufacturers and the users in the power and process industries, can be expected to lead to the extension of automation in these fields. This implies adding recording in machinable form, such as tape, and control functions to the system in order to mechanize the feedback loops of fig. 1. Eventually, self-adapting and optimizing machines that include control and evaluation procedures will assume the duties of the operating staff and some of the functions of the supervisory staff. Academic studies show that such machines will be capable of solving system problems beyond the intellectual power of their human designers. This advanced work was begun recently in the United Kingdom and is being pursued at the University of Saskatchewan.

Meanwhile, industrial data reduction provides an open field for the application of electronic computer techniques. Current requirements are to eliminate recording monitors, scan recorders and hand records, and to provide a plain language direct reading presentation of operational data.

END

Dr. W. E. Glenn of the General Electric Research Laboratory demonstrates his new thermoplastic recording system. At top he records a television signal, then in lower picture shows how tape can be "played back" in standard 16 mm projector equipped with special light source and grating.

Thermoplastic film combines advantages of optical and magnetic recording

Dr. William E. Glenn, physicist at the General Electric Research Laboratory, Schenectady, N.Y., has invented a new recording system called thermoplastic recording (TPR). The new system, which is still in development, combines the processing speed and much of the versatility of magnetic recording and the storage capacity of photography, and it offers some advantages over both of these recording systems.

Thermoplastic recording can already concentrate 100 times as much information in a given space as can magnetic recording, and it has the potential for still greater concentration.

Like photography, TPR possesses the advantage of almost instantaneous recording, but it does not require the chemical processing needed by photographic film. It can record both in color, and black and white, be erased and reused, and record electrical signals at bandwidths well in excess of video bandwidths. To read out the information requires a simple modification of standard projection equipment.

The recording is made in the form of small ripples on the surface of a plastic film. The ripples are formed by means of an electron beam, which scans the surface of the film. The recorder has an electrical input similar to a magnetic tape recorder, and an image output that is similar to photographic film. The latter can be changed to an electrical output signal by standard techniques.

Fig. 1 shows the recording process and one type of thermoplastic film. The film has a base that is similar to the standard moving picture film base. On top of this is a transparent conducting coating, and on top of the transparent coating there is a thin coating of thermoplastic material. This material will melt if it is raised to a fairly high temperature.

The surface of the thermoplastic is charged with an electron beam in a pattern that corresponds to the pattern of ripples that is to form the image. As the film moves on, a current is induced in the transparent conducting coating, which heats the film so that the thermoplastic coating melts. The charges are attracted to the transparent conducting coating and depress the surface of the thermoplastic. After the surface has been deformed by the charges, the film is then allowed to cool; this freezes the ripple pattern in place.

To erase the information, you simply heat the thermoplastic again to a higher temperature, so that the charges leak away and surface tension smooths the surface back out to its original state. The film is then reusable.

Fig. 2 is a diagram of a recording machine that records on thermoplastic film in this way. The film, of course, must be handled in a vacuum, since the electron gun has to work in a vacuum.

The signal input, in this particular recorder, is simply the intermediate-frequency signal out of a black-and-white TV set, at about a one-volt level. If the images are to be recorded in color, another signal has to be added to another electrode, also at about a one-volt level.

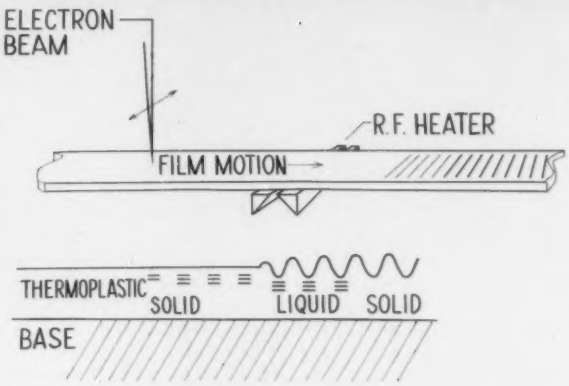


Fig. 1 (L) Mechanism for thermoplastic recording, and cross-section of TPR tape.

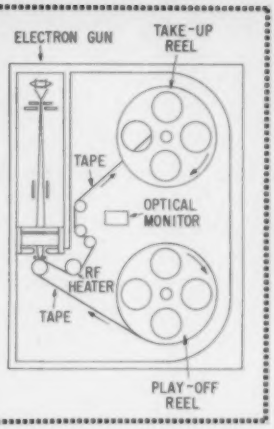


Fig. 2 (R) Schematic of TPR recorder.

Special optical system produces images

It is not difficult to produce visible images from the ripples on the film. In black and white, this is done with a modified Schlierien optical system. In color, it is necessary to use a special optical system invented by Dr. Glenn and described fully in a paper in the Journal of the American Optical Society, November, 1958.

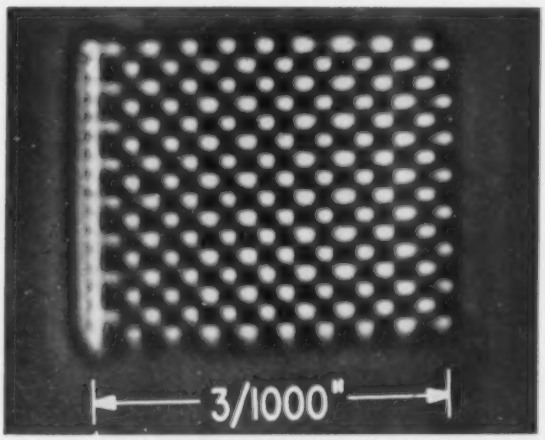
Fig. 3 shows how a standard projector works. It has a plane light source, a condensing lens, and a projection lens. The light source is imaged on the projection lens by means of a condensing lens, and the projection lens images the slide to be projected on the screen.

Replacing the plane light source with a line light source as shown in Fig. 4, and imaging them on a set of bars in front of the projection lens, no light will get through to the screen. However, ripples on the surface of the film at any point will scatter light through the bar system. Thus, the bar system acts somewhat like a shutter that allows light to pass wherever there is a ripple on the film. Wherever light passes through the projection lens, it images the ripple on the screen as a white spot.

This system can be modified so that it can be used to produce color pictures. Fig. 5 shows how. Each picture element has in it a set of ripples that form a little diffraction grating. The light that is diffracted by this grating forms a spectrum on each side of the central beam. The slots are made small enough so that only one color gets through to the projection lens. Since the projection lens can receive only one color, the spot that appears on the screen will appear in a single color. Another color can be obtained by changing the spacing of the grating. Superposition of two or more colors is obtained by superimposing the required grating in that spot.

At present, the film used by General Electric is the size of standard 16 mm film, recorded either half width (5 mm wide) and run at 10 inches a second, or half of that again (1/10 inch wide) and run at 5 inches a second. In the latter case, this is the width of a half-track of standard audio magnetic tape.

However, the speed in the latter case is only 5 inches a second rather than at 7½ as used in audio recording. And the new tape is recording video signals. END



Pattern on thermoplastic film shows it is possible to record at rate of forty million bits per square inch.

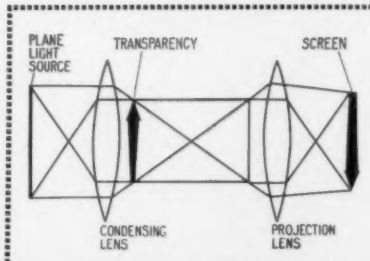


Fig. 3. Conventional projection system.

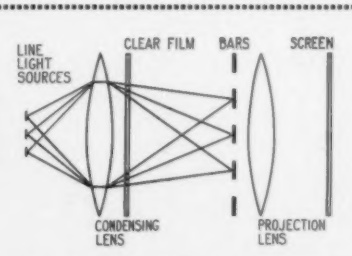


Fig. 4. Projection system suitable for TPR.

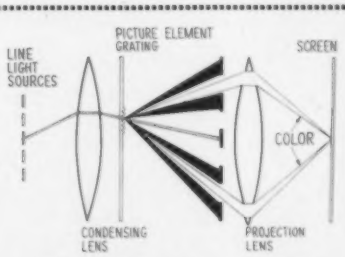


Fig. 5. Color projection using TPR system.

Are your schematics doing their job?

M. BARLOW, MA, AMBRIT. IRE*

A plea is entered for greater care in the drawing of circuit diagrams for electronic equipment. Since the serviceman will make the most use of a diagram, it should show him clearly how the circuit operates. Various methods of achieving clarity are described that can help speed up servicing

The drawing of circuit diagrams has become so bound by regulations in many companies that there is a danger of the drawings losing their usefulness. Information which should logically be found on the diagram has to be omitted because it does not conform to Drawing Office (DO) standards, and the circuit becomes difficult to follow in consequence. Practically every engineer and draughtsman has his own pet theories on how circuits should be drawn, and many people have very strong views indeed. The writer admits to having been infuriated on many occasions by someone else's circuits, and offers the following comments for thought.

The first point that should be decided is just for whose benefit the circuit is being drawn. This may seem elementary, but it usually happens that the originator of the circuit diagram is the engineer who worked on the prototype — and he is, presumably, very familiar with its operation. Consequently he may not draw the diagram in such a way as to accentuate its operating principles. Even if he does, the DO may "tidy up" his sketch in such a way that the operation is now quite camouflaged.

The man who really needs the circuit diagram is the service engineer or technician, and since he may not be dealing continuously with this one unit, the information on the circuit diagram should be displayed in such a way as to give him maximum help in the shortest possible time. He should not, for instance, have to refer to other diagrams just to locate what the external connections to the unit are. Unfortunately, in many companies this responsibility to the serviceman is overlooked, although ease of servicing is often a prime contributor to good sales.

Often there is no senior employee responsible for ensuring that service data is as complete as possible in the sense that it is clear and understandable. Those companies that have technical writers to compile handbooks rarely give them authority to demand drawing changes that would lead to a clearer understanding of the circuit. It should be clearly understood that it is the responsibility of the original development engineer that his circuits should be drawn to his satisfaction, and that if there is any disagreement between DO procedure and the engineer's ideas on clarity, the engineer's decision must be final.

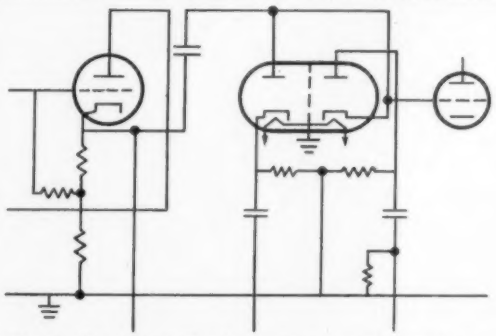
A typical example is given in Fig. 1. This shows a diode clamp circuit as it is often drawn in the DO (Fig. 1a), and as it should be shown to accentuate its operation (Fig. 1b). The second drawing shows at once the nature of the bridge circuit involved, giving immediate clues to possible faults.

Developing the serviceman's requirements, we must obviously consider both the probable technical abilities of the serviceman, and also the quality of the product being serviced. Another point to consider is the speed with which servicing must be performed. In a broadcast transmitter, for example, product quality is high and breakdowns are rare, so the serviceman (who will be of high calibre) will not have had much experience in faultfinding on the unit in question. Further, every minute the unit is out of action is vital, so the maximum information should be included on the circuit diagram in the clearest possible way. On the other hand, aircraft electronics units can usually be replaced entirely in order to get the aircraft away, and time is then available for more leisurely servicing on the ground.

Schematics should show how circuit works

What, then, should be shown on the circuit diagram? In the writer's opinion, it cannot be overemphasized that

*Canadian Marconi Company, Montreal.



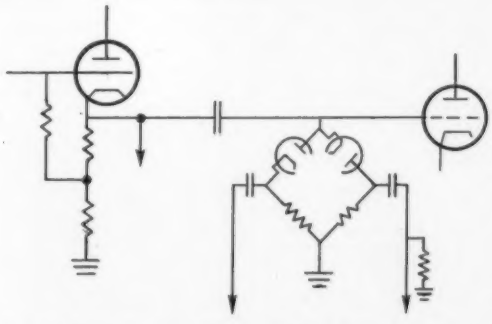
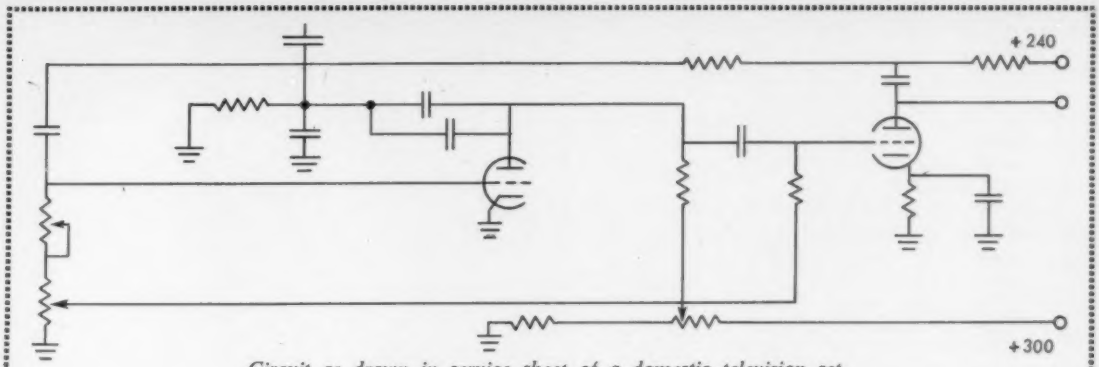


Fig. 1a (left). A diode clamp circuit exactly as drawn in a well-known textbook. Note how confused the whole diagram is, due to the number of parallel lines and the large size of the symbols. Fig. 1b (right). The same circuit redrawn to show that the first stage is a cathode follower, that the clamp is a bridge circuit, and that it is shunted across the signal path rather than in series with it. Using slightly smaller symbols or more space has helped to clarify the diagram. The ground and heater connections to the diode are omitted as of no help to the serviceman.



Circuit as drawn in service sheet of a domestic television set.

the most important and most helpful thing about a circuit diagram is that it should show how the circuit works. The diagram should flow, usually from inputs at the left to outputs at the right. Standard circuits such as multivibrators should be drawn as such; bridges and series stabilizers should look like such. If tubes or components have to be put in at odd angles, put them in at these angles as long as this contributes to the understanding of the circuit. Leave spaces between the various sections of the circuit, and if this means using a larger sheet of paper, then DO rules should not be so restrictive as to prevent this. There is no need to use continuous ground lines, B+ rails and the like for all sections of the circuit. Break them up if it helps. Similarly, long leads all over the drawing can often be replaced by a labeled arrow and a grid system of component location.

The point is that if the diagram is clearly laid out, the average person has enough technical knowledge to understand it at a glance without having to refer to a block diagram. Block diagrams are popular, but how many of them are ever laid out to match the layout of the circuit diagram? Fig. 2a shows an example of a circuit from a service sheet on a domestic TV set. Fig. 2b identifies the circuit type much more quickly, and there is much less chance of mistaking a vital component for something else.

Having once laid out the circuit in such a way that the operation of each section is immediately obvious, the individual component values are added in the usual manner. Regular DO procedure is to make all symbols for regular parts the same size, but in some cases the circuit operation is clarified if some distinction is made between the important and the unimportant components. Thus grid stoppers are not as important as plate load resistors or grid leaks, and if, as in much video equipment, nearly every tube has plate, screen and grid stoppers, there is obviously a case for making the circuit symbol smaller for these components. This relieves the diagram and helps emphasize the important components. Naturally, this should not be overdone; there should not be more than two sizes of symbol or confusion will be worse. Stoppers should be drawn as they are wired — right up against the socket, and preferably they should be drawn in the same direction as the electrode being stoppered, as in Fig. 3. Another very useful clarifying trick is always to draw potential dividers of any type vertically, whilst coupling components across which there is no potential should be drawn horizontally, as in Fig. 4. Of course, in some cases the coupling component is part of a potential divider, especially at extremes of the frequency range, and this can be accentuated or not by drawing it as such. If there is any doubt about any point, it is simply resolved by asking yourself, "Which way makes the operation easier to understand?"

Apart from the component types and values, tube types and socket connections, what else should be shown? The answer here is, "Anything that will make servicing easier and quicker without confusing the diagram." Thus fixed voltage rails should be marked with the normal voltage reading, but tube pins, whose voltages may vary with either tube tolerances or signal conditions, should not. The color coding of the wiring should also be indicated, as this is a great help. Input and output socket connections should be

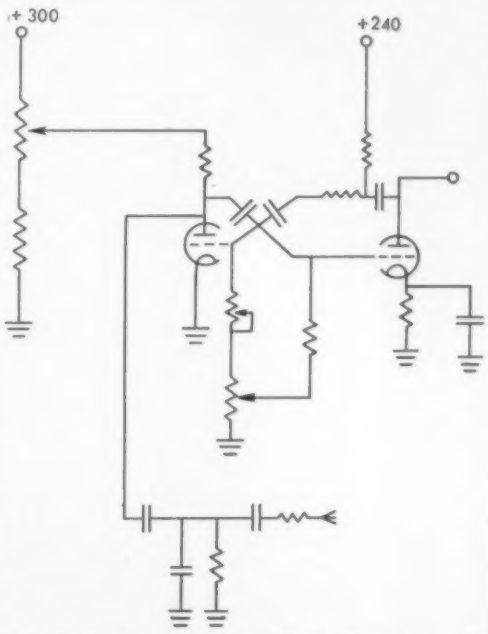


Fig. 2b. The same diagram as in fig. 2a, redrawn to show that the circuit is a plate-coupled multivibrator, and the electrical action of the controls. Note that the unexpected components in the plate and cathode circuits of the right-hand tube are immediately obvious. The components associated with the trigger pulses also show up at once.

shown, and, if it helps, not just as "SK1, Input" but as "SK1, BF0 Input." Similarly it may often help to indicate to which unit the output goes. Plug and socket connections can also be marked: "AGC OUT," "TIMER IN" and so on. Where several units are fed it may be better to put "TO P3 SKC MIXER P11 SKA RF." If there are several possible combinations of units, then the connection should just be marked with its internal function, such as "MIXED BLANKING OUT."

Every control and adjustable component should be marked with both its component identity and its purpose—and the marking for the latter must agree with what is marked on the chassis or panel. If there is no room on the diagram, use a bigger sheet or mark all controls along the bottom edge of the drawing, or refer to them by a grid location. The writer personally finds the little arrows near variable resistors to indicate clockwise rotation rather useless. If the circuit is properly drawn, there is little doubt as to which way the control operates, and it is rare for the information to be of much value. Similarly, the addition of working voltages, wattage ratings, and polarites of electrolytic capacitors (which are already indicated if the symbol is correctly drawn) merely clutter up the drawing and are of no real value. An exception is when the indication of characteristics gives a clue to size and so helps component identification on the chassis.

After the generalities, some details. Here we run up against DO regulations in some cases, and Government specs. in others. However, where a company is free enough and bold enough to review its procedures, a few pointers may help.

In the matter of component numbering, a logical sequence of numbers is always aimed at, but due to modifications this is not always possible to maintain. The only way to be sure that there is a C64 and only one R39 is to have a table of component numbers by the draughtsman's elbow, which he can tick off as he proceeds. Now if this table is added to the drawing, it is simple to add a grid reference to each component to find it on the circuit diagram. The diagram can be labeled with, say, letters along the top and numbers down the side. This saves both DO and servicing time, as one can now work backward quickly from a component on the chassis to its location on the circuit. Furthermore long leads across the circuit can be replaced by little arrows labeled "To B4" or "From D9" etc. Since there is a record of which component numbers have actually been used, there is no ambiguity when modifications have to be made. Deleted components are crossed out from the location table, and new ones are added in sequence. All components, including coils, transformers and tubes, should be on this list.

One minor irritation is the insistence of some companies on starting, not with R1 and C1, but with R01 and C01. Apart from confusion caused by "0" and "O" (number and letter) with some combinations of initials,

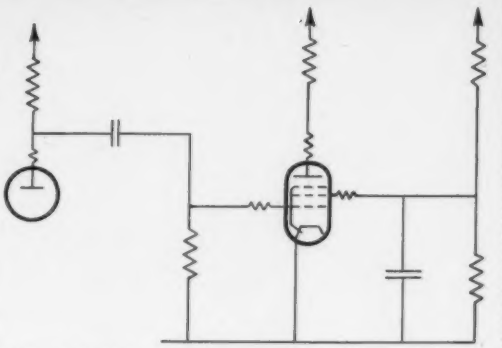


Fig. 3. Using a smaller symbol for stopper resistors throws emphasis on the important components.

it is illogical, especially when there are more than 100 resistors. Perhaps in this case we should start at R001? This sort of thing adds unnecessary lettering to the circuit diagram, not to mention increasing the cost of any chassis lettering employed. R1 is clearly the first of the R series whilst R01 is, or should be, the first of the R0 series.

Another waste of time is the block which says "K = 1000, all C's in mfd, etc." often found on circuit diagrams. One would have thought that by now the symbol K was sufficiently well known by anyone able to read a circuit diagram. With regard to the other units, we are in some difficulty due to the use of $\mu\mu$ or mm instead of the more international p. Thus a European circuit diagram, requiring no explanatory block, would have all capacitors in microfarads unless followed by a p. Similarly all resistors would be in ohms unless followed by a K or M, and all inductances in Henries unless followed by an m or μ. The letters mfd, H or ohms never need appear on the diagram. Our difficulty arises over the ambiguity of adding a μ after, say, 470 (for 470$\mu\mu$F) which might be mistaken for 470μF. To avoid this ambiguity it is necessary to use farads throughout and so sprinkle the whole diagram with μ and $\mu\mu$. It is suggested that strong minded DO chiefs should now insist on pF for $\mu\mu$F or mmF.

Modification notes can also cause trouble. It is essential that the modification note should indicate what was the previous value, e.g. "R69 was 10K," and, of course, the date of change. In some instances it would also be a help to know the serial numbers of already modified units. This is particularly the case where the modifications are sufficiently extensive for a new drawing to be made. "All units prior to serial 1001 refer to circuit diagram XYZ123" is quite enough. The really useless modification note is that

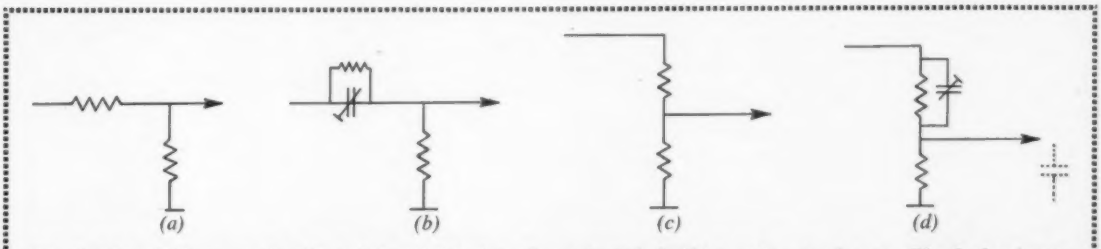


Fig. 4. (c) and (d) are preferable to (a) and (b), since the potential dividing action is clearer. The lack of symmetry in (d) immediately reminds the reader that an important stray capacitance probably follows.

which just gives a date and change-order number, so that the serviceman has no idea whether his unit is up to date or not. If in addition the master drawings have been altered, then there is no record left of the circuit diagram of the first units in the field. In these circumstances the servicing job can be really hard.

Although most of these points apply mainly to industry, there is one final beef that the writer would like to get off. That is against those magazines which number the components of the diagram, but give the values in a separate table underneath. By the time the author, typist, draughtsman and typesetter have all been at work, the likelihood of error is extremely high. If there is no room for component numbers and values, then only include those component numbers needed for any explanations in the text. The table is still required to specify wattages and voltages, but there is now a positive check on the components being correctly marked.

The various points mentioned are individually small. Collectively they can make or break a quick-servicing policy. None of the points should require DO or engineering changes to introduce, but if they do, it is suggested that the DO procedures themselves may be too rigid. If any reader is content that his own output of circuit diagrams is beyond reproach, let him find another engineer who is not familiar with his product, and put him to explaining the circuit diagram and its operation. If this can be done quickly and accurately, then it may be that the circuits are in fact sufficiently well drawn, but in the writer's experience, this is highly unlikely. END

Engineering reports

Tramp metal detector stops pulp mill damage 141

Tramp metal, pieces of metal which get into logs, can cause severe damage to chippers in pulp mills. Measurement Engineering Ltd., Arnprior, Ontario recently developed and installed two tramp metal detectors at the paper plants of Anglo Canadian Pulp & Paper Co. Ltd., Quebec City, and at Gaspesia Sulphite Ltd., Chandler, Quebec.

The detectors are set to detect any piece of metal passing through the aperture, then automatically stop the conveyor so that the metal-bearing log can be removed.

The equipment consists of two main parts, the search head and the control unit. The control unit houses the oscillator, amplifier and stabilized power supply. When the equipment is working, the oscillator generates a continuous signal which is passed to the search head. The signal returned to the amplifier in the control head is altered if tramp metal is present and a relay is operated. The relay can be used to set off an alarm, operate ejection equipment, or stop the conveyor.

The unit illustrated has an aperture 60 in. by 48 in., and while the largest to date, it does not represent the practical limit.

Nixie tubes help prevent aircraft accidents 142

Two Burroughs Corp. Nixie tubes, whose glowing numbers enable pilots of the RCAF to more easily change radio channels while flying at near sound barrier speeds, have made flying safer for airmen of the Canadian Air Defence Command.

Formerly, when a pilot changed radio frequencies he had to look down, twist his body sharply to the right, and try to select a new channel. In looking up suddenly, some pilots suffered vertigo and had difficulty keeping control of their aircraft. In such situations, pilots have been known to reverse their controls, i.e., make a left instead of a right turn.

"In tests several years ago," said an RCAF research engineer, "researchers learned that if a pilot was blindfolded and the blindfold was removed, it took him about 11 seconds to recover. A similar situation was created when we changed radio channels the old way."

The problem was solved when engineers placed two Nixie tubes on the aircraft's instrument panel and wired them to the radio channel selector switch. When the pilot switches channels the figures in the Nixies duplicate the reading on the jet's radio dial. The Nixies are shown circled in the photograph.

All Canadian CF-100 all-weather interceptors are equipped with the remote channel indicator, and the RCAF is now in the process of installing it on their F-86 Mark V's and VI's and T-33 jet trainers.

Direct lines cut intercompany telephone costs 143

Canadian business is looking to streamlined communications for greater productivity, increased administrative efficiency and better customer service.

An example is the Canadian Westinghouse Company where direct long distance dialing will go into effect this month between the firm's main plants and offices at Hamilton and distribution centres and offices in the Toronto area. Calls between the two cities will be made without the service of long distance operators or switchboards.

Westinghouse is already examining the economic merits of an even broader and more complex system by which direct long distance dialing would be possible between company plants and offices in 57 cities across North America.

Last February the firm had the Bell Telephone Company install a large switchboard at Hamilton to centralize telephone service for some 1,200 company extensions (locals). The board, with a single telephone number for all plants and offices in the city, replaced six boards with different numbers. A similar centralized board went into service in Toronto last August to link company centres with a single telephone number.

Installation of the central board at Hamilton has made possible the most efficient use of the firm's direct lines to other cities. By using these lines, provided by Bell Telephone, employees in Hamilton and Toronto by-pass long distance operators on inter-city calls, although at present they must place them through their respective switchboards. When the new system becomes automatic this month, the caller will simply dial direct to the company local desired in the other city.

In addition to Toronto, such centres as Montreal, Ottawa, London, Brantford, Buffalo, N.Y., and Pittsburgh

are linked by direct lines to Hamilton. Pittsburgh is the focal point for an amalgamated company network in the U. S. through which 29 cities may be contacted with use of regular long distance facilities.

Using direct lines presently in service, Westinghouse is saving between $2,000 and $3,000 monthly on long distance telephone bills, according to P. J. Forstner, communications supervisor.

"In addition to the significant reduction in communications costs, the new system has brought improvement in relations with our customers," Mr. Forstner stated.

"Installation of the single board at Hamilton has enabled us to make full use of direct lines and to reduce considerably the number of calls formerly placed through long distance. This reduction amounted to 59% in one recent peak month—a substantial saving," he said.

Sputtering techniques reduce component size 144

Sputtered thin-film resistors, formed from refractory metals such as tantalum and titanium, may be one of the more important developments in microminiature electronics. Such resistors can be produced on glass or ceramic bases in lines as narrow as 1 mil (0.001 inch), spaced 1 mil apart, thus producing extremely high resistance in a small area.

The newly announced minitature resistors owe their success to a high precision masking process, which makes it possible to produce the thin films in specifically restricted locations. An expendable copper mask is used for this operation.

In producing a resistor, an over-all thin film of copper is first deposited onto the ceramic or glass base, for example, by sputtering. Then, the desired pattern is etched into the copper surface by standard photoetching techniques, leaving the bare substrate exposed. Tantalum, other refractory metals, or electrically useful alloys are then deposited onto the etched copper pattern, and the whole unit placed in an etching bath. The copper with its overlay of tantalum is removed, leaving behind only the tantalum which was in direct contact with the bare surface. Since the masks are extremely thin, fine detail is possible. Also, since the sputtered materials adhere to the substrate itself, support considerations are not necessary and complex patterns can be produced.

In the photograph, D. A. McLean, Bell Telephone Laboratories, compares the reduced size of a printed circuit using his newly developed sputtered resistors, with the comparable conventional printed circuit board in his right hand. END

For your library

New text provides latest data on noise in electron devices

Noise in Electron Devices

L. D. Smullin and H. A. Haus; M.I.T. Technology Press and John Wiley & Sons, Inc., New York; 413 pp; $12.

Reviewed by B. A. McIntosh, Radio and Electrical Engineering Division, National Research Council.

It is always a pleasure to see a book which combines under one cover the most recent theoretical and experimental advances in a particular field. This book had its origin in a two-week course on noise in electron devices given at M.I.T. in 1955. The seven authors, all outstanding contributors in this field, have enlarged upon and brought up to date the material they presented then.

In Chapter 1, C. F. Quate looks at the basic source of noise in electron tubes — the thermionic cathode. The presentation of the low-frequency noise analysis of a thermionic diode follows the "classical" lines of Fry-Langmuir, North and Rack. More recent work on the multivelocity diode at high frequencies is mentioned briefly. Although progress is being made on this aspect of noise behaviour, an adequate theory has yet to be produced.

Low-frequency noise—the so-called "flicker effect" — is reviewed by A. Van der Ziel in Chapter 2. Since this is a field in which he is actively interested, much of this chapter deals with his own recent experimental results. Although much is known about flicker effect, a comment that Van der Ziel frequently makes about particular aspects of the phenomenon is significant: "The reason for this behaviour is not clear, and more work has to be done to gain a better understanding of the effect."

H. A. Haus deals, in Chapter 3, with signal and noise propagation along an electron beam. Haus's elegant matrix formalism for the mathematics of signal and noise propagation is a powerful tool since it is applicable to all beam-type micro-wave amplifiers. Concerning the noise figure of such amplifiers the theory establishes a lower limit which is a function solely of the noise processes in the region of the potential minimum in the electron gun. Unfortunately it is precisely in this region where noise behavior is least understood.

The subject of noise in grid-control tubes, treated by T. E. Tapley in Chapter 4, is familiar to most engineers. The theory of noise in common receiving-type tubes is reviewed and includes such topics as induced grid noise, partition noise, circuit representations of noise sources, and the measurement of tube noise and noise figure. A useful table is presented of measured values of plate noise and induced grid noise (in terms of equivalent noise resistances) for common tubes.

R. W. Peter discusses low-noise traveling-wave tubes in Chapter 5. Since, as mentioned above, minimum noise figure depends ultimately on noise processes in the electron gun, much of the chapter is devoted to a detailed discussion of low-noise electron guns. Also treated are noise due to interception of current, lens effects, and methods for measuring beam noisiness and amplifier noise factor. The practical design of an actual S-band low-noise tube is carried out in detail.

Chapters 6 and 7, on noise in semiconductor devices, by A. Van der Ziel and W. H. Fonger deal primarily with basic noise behaviour but include a brief section on the design of low-noise transistor amplifiers.

Each chapter of the book can be read as a separate entity. This implies a certain amount of duplication in the introductory background material, but it is by no means tedious nor wasted. Extensive bibliographies of from 20 to 70 items are included by each author.

This book contains material that will be of great value to the research worker and also to the engineer looking for a clearer understanding of the physical processes and theories behind his design equations.

The Physics of Electricity and Magnetism

W. T. Scott; John Wiley & Sons, Inc., New York; 635 pp; $8.75.

Reviewed by R. F. Scott, Radio and Electrical Engineering Division, National Research Council.

To the many books that deal with electricity and magnetism to an intermediate level, this volume by Professor Scott should be a welcome addition. The writing is lucid, and numerous illustrations add to the clarity of the text. Many references are cited which will aid the reader who desires to enter more deeply into the various topics discussed. In addition, several illustrative problems follow each section of the book. The mathematical level required is modest, and only elementary differential and integral calculus is essential. Vectors and vector notation are employed throughout, the necessary properties of vector fields being derived in one of the several appendices. MKS units are primarily employed. A convenient (although not essential) practice is the statement of important formulae in both MKS and Gaussian units.

The discussion of electrostatics is conventional, with Coulomb's law for the force between two charges at rest providing the foundation of the treatment. On the other hand, the theories of metallic conductors, semiconduction and thermoelectricity are considered in the light of modern solid-state theory. Sufficient background material on these topics is provided to enlighten the reader to whom the subject is new.

In the exposition of magnetism, again a modern viewpoint is adopted and, whereas in the past it has been customary to define magnetic field (H) in terms of the force on a unit "magnetic pole" in the presence of magnetic poles of known strengths, here the Lorentz force law which involves the magnetic induction (B) is treated as fundamental. Not until the chapter on magnetic materials is explicit mention made of H.

The treatments of direct- and alternating-current phenomena are standard; in the latter, the complex number method of a-c analysis is employed. Sections on non-sinusoidal alternating currents, and the analysis of transients and pulses, are included.

The final chapter consists of an introduction to the theory of electromagnetic radiation on the basis of Maxwell's equations. Wave-like solutions of these equations are demonstrated. Propagation along coaxial cables and in waveguides is briefly treated, and the connection between special relativity and electromagnetic theory is discussed.

Components for military applications, catalogue No. 50, is simultaneously a handbook on U. S. military specifications covering resistors, capacitors and relays. Ohmite Manufacturing Co., Skokie, Ill. (101)

Digitizer handbook (76 pp) covers the theory data reduction and digital control systems. Coleman Electronics, Inc., Gardena, Calif. (102)

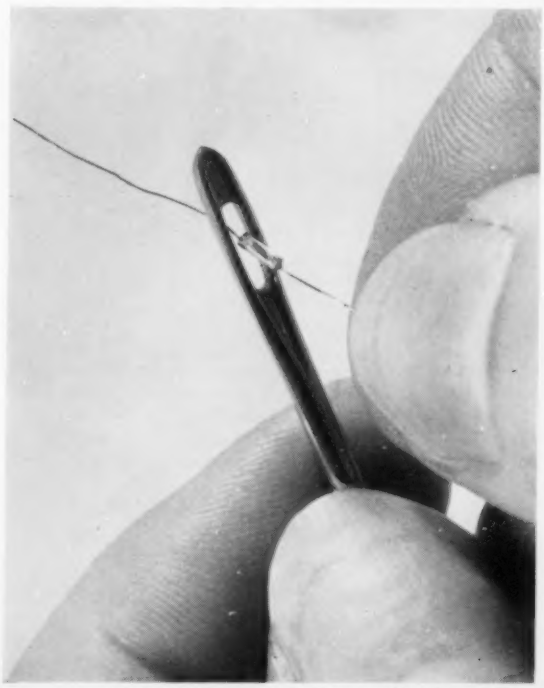
Masts for television, communications and broadcasting. Catalogue from Beatty Bros., Ltd., Fergus, Ont. (103)

Technical data on precision wire wound and composition variable resistors—24 page engineering catalogue from Reon Resistor Corp., Yonkers, N.Y. (104)

Two extremes in powdered iron cores are these with diameters of 5.218 and 0.260 inches. They are made by The Arnold Engineering Co., Marengo, Ill. Core at right was developed for filters used in guided missiles. It weighs 1/3 ounce.

What's new in view

The eyes of our industry

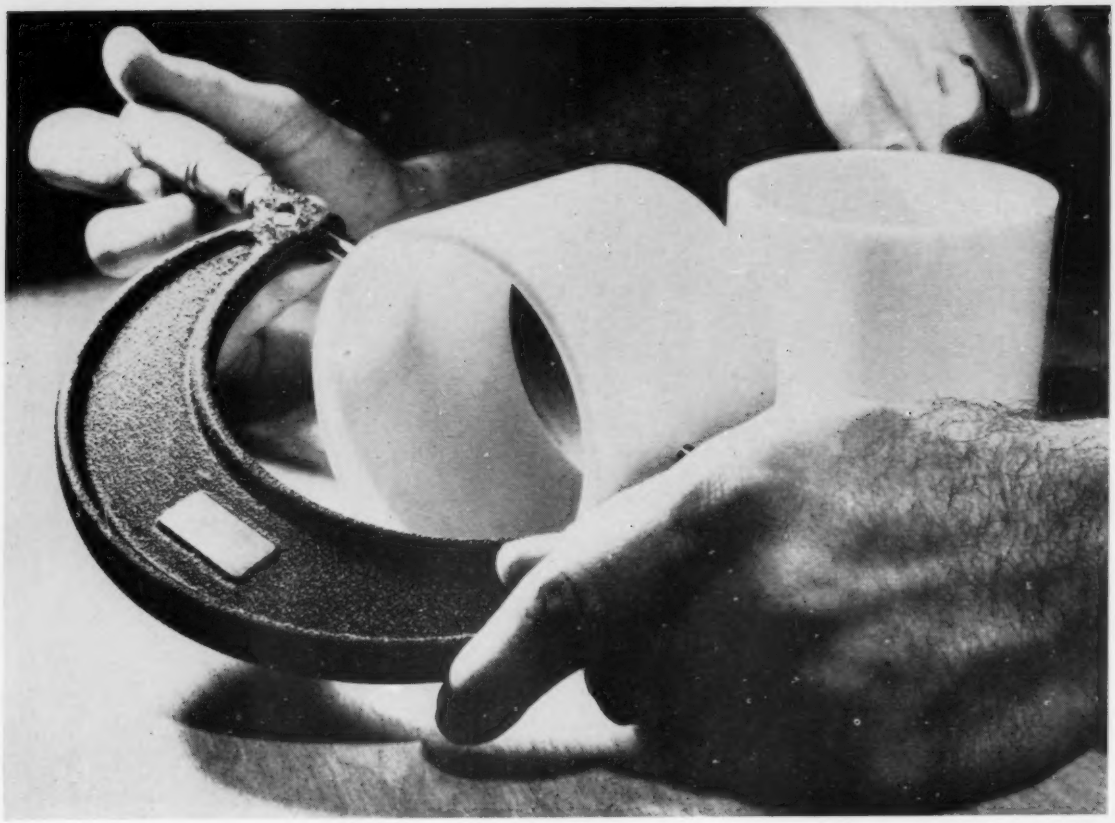


New lamp developed by Sylvania Lighting Products claimed to be smallest incandescent lamp in mass production.

Manual angle tracking capability developed by Boeing Airplane Co. permits plotters to track airborne weapons. Made for use with Boeing IM-99 Bomarc weapon systems, it can be used where large electronic plotters are not available.

Skilled operator at Mullard Southampton Works uses precision ultrasonic drill to cut crystals for r-f transistors.

On the tube assembly line at Mullard Southampton Works, girls seal glass envelopes to feet using induction heating.



111

New products

Ceramic for vacuum tubes 111

Berlox EM beryllia has all the properties which have made berylium oxide valuable in a wide variety of electronics applications. In addition, it is vacuum tight, free of outgassing, and has a surface especially well suited to metallizing. It is available in rods, tubes, cylinders and bulk shapes such as blocks and plates, plain or machined to specifications.

Electrical insulating value is retained at high frequencies and elevated temperatures. High hardness, low coefficient of expansion, and good thermal shock resistance, are other properties.

National Beryllia Corp., North Bergen, N.J.

Microwave duplexer 112

Model WR-137 ferrite phase differential duplexer provides the advantages of both a duplexer and load isolator in a single unit. It consists of a folded matched tee, the ferrite sections, and a short slot hybrid coupler with a dual adaptor which connects a matched load and antenna to the hybred. Frequency range is 7125 to 7650 mc; transmitter to receiver isolation is 25 db minimum; antenna or load to transmitter isolation is 20 db minimum; instration loss is 0.4 db maximum; input vswr is 1.15 maximum; power handling capacity is 10 kw peak and 10 watts average.

Airtron Canada Ltd., Toronto.

Sensitive image orthicon tube 113

Image orthicon tube type GL-7629 requires only about 1/10 to 1/20 the light needed by standard image orthicons. It can produce pictures of usable black-and-white quality at one foot candle of scene illumination or less. Sensitivity of the new tube results mainly from a high-gain, thin-film target of magnesium oxide approximately two millionths of an inch thick.

Unlike conventional targets which rely on ion conduction, the new tube uses electron conduction. This is a reversible process, and the life of a tube is not limited by the exhaustion of charged carriers thus, the problems of "stickiness" and "burn-in" are virtually eliminated so that expected tube life is appreciably extended. The new target is also responsible for improved resolution.

Canadian General Electric Co. Ltd., Electronic Tube Section, Toronto.

Gridded traveling wave tube 114

A new 1 kw traveling wave tube combining periodic focused permanent magnet (ppm) with a gridded gun is being produced by Hughes Aircraft Co. Designated the MAS-IE traveling wave amplifier, it has a peak output in excess of 1 kw with an input of only 0.5 w. It operates in the S-band from 2.00 to 4.0 nc (nanocycles, or kMc).

Use of a control grid enables the tube to operate with a very fast response time with lower power consumption and simpler modulation problems than in previous tubes. Permanent magnet focusing offers such advantages as light weight, no solenoid power supply needed, low heat generation and better reliability.

R-O-R Associates Ltd., Don Mills, Ont.

Electronic wattmeter 115

Weston electronic wattmeter model 1483 has been designed for measurements at sustained accuracy and resolution down to 0.01% of rated input. Ranges are 250/500/1,000 watts. Input

current is 5 amperes normal and 10 amperes maximum; potential is 50/100/-200 volts normal and 75/150/300 volts maximum. Output is 1 ma into 5,000 ohms. Frequencies are dc and ac (40 to 1,000 cps).

Since output of the instrument is a low impedance dc, the wattmeter can be used to actuate digital meters, remote-indicating meters, and to drive strip-chart recorders. True temperature compensation has been achieved by making the air gap in its galvanometer increase with increasing temperature to compensate for decreased current in the moving coil.

Daystrom Ltd., Toronto.

Motorized rheostats 116

Ohmite Manufacturing Co. has introduced complete motor-driven rheostats and variable transformers. They are designed for use in remote control applications or where a predetermined rate of resistance or voltage change must be achieved smoothly.

Standard drives consist of a motor with integral gear reducer, and cam-operated limit switches to acomplish reversal of the control. Standard assemblies are arranged for horizontal surface mounting, but assemblies for vertical mounting or any special mounting situation can be provided.

Motor-driven assemblies of ganged transformers or rheostats, or combinations of them, can be supplied. In addition to the standard ac motors, the manufacturer can supply dc or ac servo motors. Traverse time of the control can be set for the specific application.

C. M. Robinson Co., Winnipeg, and A. C. Simonds & Sons Ltd., Toronto.

Test set checks audio circuits 117

A test set for checking the characteristics of transmission lines and other voice-band equipment has been introduced by the Hallamore Electronics Co. Model TMS-0100 employs a swept-frequency generator to provide a sinusoidal wave of adjustable constant amplitude at all frequencies in the voice-band, and a crt to display in visual form the information necessary to evaluate network characteristics.

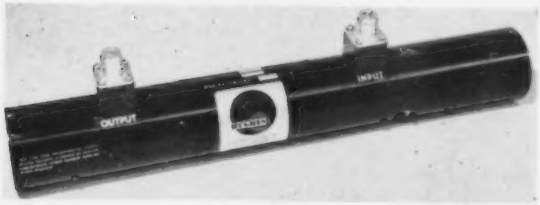
In addition to functioning as a test instrument for system gain or loss, model TMS-0100 will provide a whole-band display of relative input impedance and the transmission-frequency output characteristics of negative-impedance repeaters, equalizer networks and hybrid networks, where proper operation depends on in-circuit adjustment.

It will also provide whole-band display of relative input impedance characteristics of loaded transmission lines to detect any load misplacement or other impedance irregularities and can measure the corresponding loss of a trans-hybrid transmission system to perfect terminations and office balance.

General Communications Ltd., Toronto.

(Continued on page 58)

For further information on New Product items, use the Reader Service cards on pages 73 and 74.



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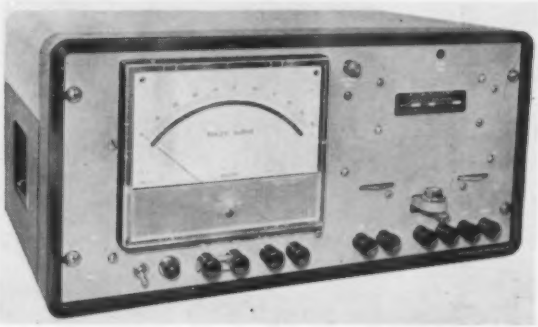

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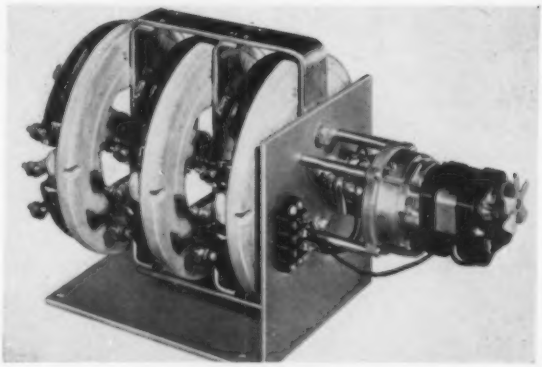

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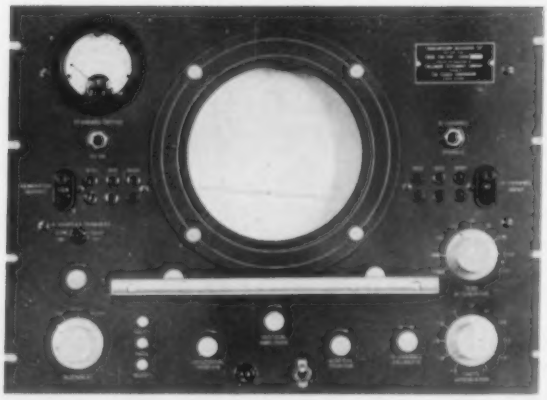

117

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For further information mark No. 33

New products—cont.

Solid state microwave limiters 118

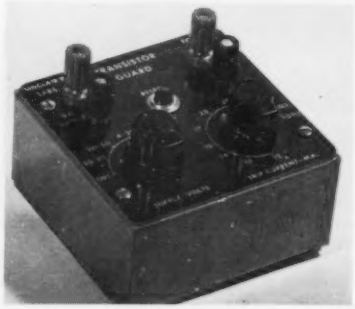
Microwave Associates have introduced two new solid state microwave limiters designed to protect uhf receivers against overload and burnout. Models MA-3400 and MA-3401 can be used as low-level crystal protectors in duplexer applications, and can serve as solid-state protectors with traveling wave tube amplifiers, communication receivers, etc. They can also form part of a low-insertion loss switch for use in front of parametric amplifiers.

Centre frequency of model MA-3400 is 425 mc ±5%. For the MA-3401 it is 600 mc ±5%.

E. G. Lomas, Ottawa.

Transistor guard 119

Transistor guard has been designed for low power transistor breadboards where burnout accident is an ever-present danger. The unit is a fast-acting circuit



breaker whose trip current is continuously adjustable from 12 ma to 500 ma. (Extended ranges available on special order). Turn-off time is about 150 usec, and this can be initiated by a 25% overload applied for 100 usec. The source voltage can be anything from 4 volts to 80 volts with an appropriate switch setting. Push-button reset is provided.

Sinclair Radio Labs Ltd., Downsview, Ont.

Rotary switches 120

Kearfott rotary switches types P1289-11A and P1281-11A are used to switch circuitry as a function of time or of shaft position. Used in conjunction with sensitive relays or solid state switching techniques, high current loads can be handled. The switches consist primarily of a bearing mounted cylinder and shaft assembly. The cylinder is divided into conducting and non-conducting segments with a continuous track for a common input. The number of tracks and the segmentation of each track is a function of the number of circuits and type of "on-off" sequence required.

Canadian Applied Research Ltd., Toronto and Lake Engineering Co. Ltd., Scarborough, Ont.

(Continued on page 62)

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Only a complete Canadian instrumentation facility can offer the kind of service Canadians need. Bach-Simpson Ltd. *is* complete — in research, design, tooling and manufacture.

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For further information mark No. 16

NEW

THE COMPACT CONTROLLER

BACH-SIMPSON
Controller-Indicators

offer sampling of pointer position at regular intervals, with positive contacting in the case of a shift of the measured quantity outside of preset limits. Contact pressure is produced by a solenoid, and is therefore independent of meter torque. Circuits of the integral primary relays are actually closed by heavy motor-driven contacts, rather than by the pointer contact itself.

Frequency, voltage, current, temperature — in fact, any quantity which can be indicated on a switchboard instrument — can be accurately and reliably limited or programmed, with simultaneous indication. A variety of sampling intervals and a wide range of contact arrangements are available, and slave units, as well as self-contained types for independent operation, are standard.

In addition, a full line of switchboard meters, compatibly styled and featuring the anti-parallax pointer and scale combination employed in the Controller-Indicators, makes possible a completely integrated panel design.

The Bach-Simpson Frequency Controller-Indicator received the I.R.E. Award for the most outstanding new Canadian component exhibited at the 1959 I.R.E. Canadian Convention.

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For further information mark No. 16 on Readers' Service Card

People — continued

Ontario Hydro manager

Succeeding **A. W. Manby** as general manager of the Hydro-Electric Power Commission of Ontario is **J. M. Hambley,** former deputy general manager.

Mr. Manby is retiring after 38 years service with Ontario Hydro, during which he has held a number of key executive positions.

Resistor engineer joins Welwyn

J. R. Bach, president of Welwyn Canada Ltd., London, Ont., has announced the appointment of **K. R. Davis** as assistant director of sales. Mr. Davis was formerly general manager and sales manager of Renfrew Electric Co. Ltd., IRC Resistor Division.

MILNE STUDIOS

Davis

Keenan

Ontario sales representative

Jerrold Electronics Ltd. and Watkins Electronics Ltd. have appointed **A. T. (Terry) Keenan** to their respective Ontario sales divisions. Prior to this appointment Mr. Keenan was with Atlas Radio Corp. Ltd. He will continue to represent the latter company in northern Ontario.

Canadian Motorola Alberta manager

Canadian Motorola Electronics Ltd. has established a new Alberta Division and appointed **S. G. Paterson** as vice-president Western Area. His headquarters will be in the company's new offices at 10201 - 104th Street, Edmonton, Alta.

Spectroscopy expert dies

Dr. M. F. Crawford, 54, professor of physics at the University of Toronto, died January 14 of a heart attack.

Born in Thedford, Dr. Crawford graduated from the University of Western Ontario in 1926, then went on to do graduate work in spectroscopy at the University of Toronto. He specialized in research in atomic and molecular spectroscopy.

Reports — continued

I.B.M. opens new computer centre

A $1.5 million computer became available to Canadian industry to handle complex engineering problems when International Business Machines Co. Ltd. opened their 704 centre at Bayview and Eglinton, Toronto. Dr. O. N. Solandt, vice-president of research and development of CNR, spoke at the opening ceremonies on Dec. 18.

R-O-R to handle Varian products

R-O-R Associates Ltd. has been appointed Canadian representative on all Varian Associates of Canada Ltd. products, in addition to their previous representation of Varian's affiliate, Bomac Laboratories Inc., subsidiary of Varian Associates, Palo Alto, Calif.

Varian are setting up facilities at their Georgetown, Ont. plant to manufacture gas switching tubes and other products of the Bomac line and to act as distributor on the U. S.-manufactured items.

Toronto to test electronic traffic control

The Metropolitan Toronto traffic engineering department will be trying out electronic controls this year. Equipment is to be installed initially at about a dozen intersections on Eglinton Ave. that have traffic lights. Information on traffic flow is sent to a central computer that can then set the duration of "reds" and "greens" to improve the flow. Canadian Research Institute and KCS Ltd. are involved in the experiment.

ANDERSON & COLE

Signing a contract for Canadian distribution and servicing of telecast equipment manufactured by E.M.I. Electronics Ltd. of Hayes, England is R. M. Robinson, vice-president of Canadian General Electric Co. Ltd. Representing E.M.I. at the signing were K. E. Owens (seated left), manager of its Broadcast Equipment Division, and the firm's Montreal representative, Peter Macfarlane (seated right). C.G.E. broadcast sales manager, C. E. Spence (standing left) and H. E. J. Holloway, C.G.E. product planner, look on.

Frobisher Bay gets regular telephone service

The Bell Telephone Company of Canada is now providing long distance telephone service linking the outside world with the growing northern outpost of Frobisher Bay on Baffin Island. Bell will also provide expanded service at Frobisher Airport and the adjoining townsite.

Local service at the airport was initially provided by the USAF, then was taken over by the Telecommunications Branch of DOT. There are now about 200 local telephones, including 15 used by Eskimo families.

DOMINION-WIDE

Bell Telephone Co. president Thomas W. Eadie describes 1,400-mile circuit from Ottawa to Frobisher Bay to Marie Panegoosho, art editor of the Eskimo language magazine "Inuktitut", Northern Affairs Minister Alvin Hamilton, and Transport Minister George Hees. Miss Panegoosho talked in both English and Eskimo to her friend Paulette Anerodluk at Frobisher Bay during the opening ceremony, held in Mr. Hees' office on December 23.

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New products—cont.

"Magic Paper" guards secrecy 121

Using a new paper developed by Alfax Paper and Engineering Co., engineers from Alden Electronic & Impulse Recording Equipment Co. have demonstrated a new facsimile transmission method in which the message disappears from the recording paper immediately after recording, then reappears at a given time later. It allows transmissions to be received directly on the recorder, then processed into envelopes prior to the message reappearing, so that only the original sender and the recipient would see the message. The new paper could eliminate many of the problems associated with transmission of confidential documents.

Alden Electronic and Impulse Recording Equipment Co. Inc., Westboro, Mass.

Pressure transducer 122

Series SP2-518 pressure transducers feature an accessible terminal board with bobbin wound resistors for thermal gain and zero shift compensation, gain adjustment and input impedance adjustment. Balance and gain adjustments can be made in the customer's laboratory. By inserting specified resistors across the bonded strain gain bridge between the negative signal and negative excitation terminals, standardization to the instrumentation system can be checked.

The transducers come in pressure ranges from 0-50 through 0-500 psig. Bridge impedances can be specified from 50 to 2000 ohms. Sensitivity is 3 ± 0.015 mv per volt with total errors of less than 1.0% of full scale. Non-linearity and hysteresis errors combined are less than ±0.5% of full scale. Thermal zero shift is less than ± 0.01% of full scale per deg F and thermal coefficient of sensitivity is ± 0.005% of full scale per deg F over a temperature range of -65 F to + 275 F.

Standard Controls, Inc., Seattle, Wash.

Quick-connect terminals on components 123

Quick-connect terminals can now be obtained on many Ohmite tap switches, power resistors, power rheostats, relays and variable transformers. These terminals are specially shaped tabs to which

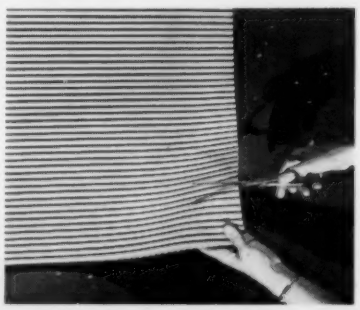
leads can be quickly connected by means of commercial quick-connect female connectors. Where specified, units can be equipped with quick-connect female terminated leads for connecting the component into a circuit already equipped with the male tabs.

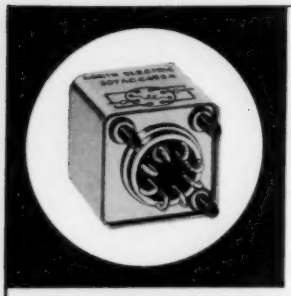
C. M. Robinson Co., Winnipeg, and A. C. Simmonds & Sons, Ltd., Toronto.

Vibration isolator 124

Vibropad is a neoprene pad for the elimination of noise and vibration from high speed equipment. When placed under free-standing equipment it helps eliminate creeping or walking of the machine. They are available in sheets 18 x 18 x ⅜ in. thick and the recommended loading is 50 lbs. per sq. in. The pads may be cut to required size with hand shears.

Vibron Ltd., Toronto.



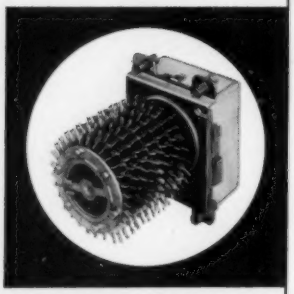


Subminiature relay IR 207

From subminiature relays to multi-line switches:

80 years of service to the communications and electronics industry have given the LM Ericsson Group of Companies unrivalled skill in the design and manufacture of relays and automation components.

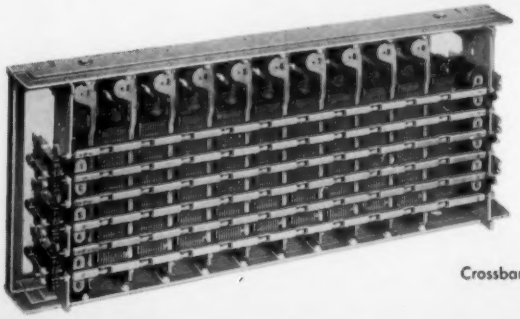
You are cordially invited to let this skill and experience work for you.



High precision rotary switch RVF

Some of the fields in which Ericsson and North relays and switches are now serving:

Airborne Navigational Aids
Computing Machines
Automatic Weighing
Airline reservations network ("Reservisor")
Missile Firing Platforms
Industrial Controls
Hydro Power Supervisory Controls



Crossbar switch

Distributors in Canada for NORTH ELECTRIC COMPANY Galion, Ohio.

ERICSSON

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For further information mark No. 26 on Readers' Service Card

15 mc silicon transistors 125

Four new high frequency n-p-n silicon transistors, designed for general purpose amplifier and switching use, all have a minimum alpha cutoff frequency rated at 15 mc. Type designations are 2N1276, 2N1277, 2N1278 and 2N1279. They feature fixed-bed pellet mounting for high mechanical reliability.

AC beta for the 2N1276 ranges from a minimum of 9 to a maximum of 22; for the 2N1277 from 18 to 44; for the 2N1278 from 37 to 90, and for the 2N1279 from 76 to 333 with a design centre at 101. The devices have typical 1000-cycle power gain ratings of 37, 39, 44, and 45 db, respectively.

Canadian General Electric Co. Ltd., Semiconductor Sales, Toronto.

Rotary switches 126

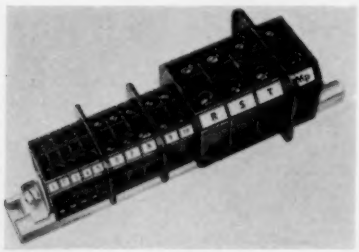
A new line of standard rotary switches has been introduced by Oak Mfg. Co. They range from 1 to 24 poles and from 2 to 24 positions. A chart is also available showing cross reference between these switches and other makes.

Radio Components Ltd., Toronto.

Modular terminal blocks 127

Staffel modular terminal blocks can be assembled on a standardized holding rail for any number of circuits. The individual terminals snap into place and, for extra security, can be locked to the track by inserting a locking pin to fasten the spring. The insulating bodies are made of melamine compounds and contacts use silver-plated copper bar.

Electrovert Ltd., Montreal.



Miniature welding head 128

A new welding head has been developed to permit the reliable spotwelding of sub-miniature parts and wires down to 0.0003 in. thickness.

Model WHD 5A has adjustable welding pressure from 1 ounce (less on special order) to 3 lb. and a moving mass less than ¾ ounce. Suspension of the welding arm is in precision ball bearings for high-speed follow-through forging action. The welding head as a built-in switch which triggers the power supply when the pre-set pressure is reached, independent of electrode settings and of the pressure applied by the operator.

Thermovolt Instruments Ltd., Toronto.

(Continued on page 65)

Synchros in sizes

08 to 23

Whatever your synchro requirements MUIRHEAD can meet them promptly—usually from stock.

MUIRHEAD synchros and servomotors are precision built to meet the requirements of Bu. Ord., N.A.T.O. and British Military specifications in sizes from 08 to 23.

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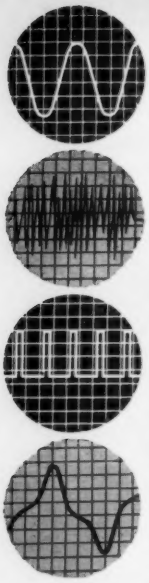


TRUE RMS

frequency range 5 to 500,000 cps

FEATURES

Built-in calibrator . . . easy-to-read 5 inch log meter . . . immunity to severe overload . . . useful auxiliary functions

SPECIFICATIONS

VOLTAGE RANGE: 100 microvolts to 320 volts
DECIBEL RANGE: —80 dbv to +50 dbv
FREQUENCY RANGE: 5 to 500,000 cycles per second
ACCURACY: 3% from 15 cps to 150KC; 5% elsewhere. Figures apply to *all* meter readings
MAXIMUM CREST FACTORS: 5 at full scale; 15 at bottom scale
CALIBRATOR STABILITY: 0.5% for line variation 105-125 volts
INPUT IMPEDANCE: 10 MΩ and 25 $\mu\mu$f, below 10 millivolts; 10 MΩ and 8$\mu\mu$f above 10 millivolts
POWER SUPPLY: 105-125 volts; 50-420 cps, 75 watt. Provision for 210-250 volt operation

measures from **100 MICROVOLTS to 320 VOLTS** regardless of waveform

DIMENSIONS: *(Portable Model)* 14⅜" wide, 10⅛" high, 12⅜" deep—Relay Rack Model is available
WEIGHT: 21 lbs., approximately

Write for catalog for complete information

BALLANTINE VOLTMETER Model 320

Manufacturers of precision Electronic Voltmeters, Voltage Calibrators, Capacitance Meters, DC-AC Inverters, Decade Amplifiers, and Accessories.

Price: $445.

BALLANTINE LABORATORIES, INC. BOONTON NEW JERSEY

BAYLY ENGINEERING LTD., FIRST STREET, AJAX, ONTARIO, CANADA

For further information mark No. 17 on Readers' Service Card

Defence contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parenthesis indicates the number of contracts, the amount being the total value.

November 16-30, 1959

- Ahearn & Soper Co. Ltd., Ottawa, radio equipment, $56,232.
- Alpha Aracon Radio Co. Ltd., Downsview, Ont., tubes, $18,465.
- Aviation Electric Ltd., Montreal, accelerometers, $35,000.
- Cannon Electric Canada Ltd., Toronto, connector assemblies, $18,069.
- De Havilland Aircraft of Canada Ltd., Downsview, Ont., electrical equipment, $44,973.
- Fleet Manufacturing Ltd., Fort Erie, Ont., repair of sonar domes, $17,508.
- Measurement Engineering Ltd., Arnprior, Ont., signal generators, $15,488.
- Northern Electric Co. Ltd., Ottawa, spares for teletypewriters, $11,703.
- RCA Victor Co. Ltd., Montreal, tubes, $23,291.
- Redifon Canada, Montreal, installation and testing of action speed tactical teacher, $74,257.
- R-O-R Associates Ltd., Don Mills, Ont., equipment, $12,735.
- Servomechanisms (Canada) Ltd., Toronto, development contract, $10,169.
- Sperry Gyroscope Co. of Canada Ltd., Montreal, tubes, $19,324; aircraft navigational equipment, $275,392 (3).
- Sylvania Electric (Canada) Ltd., Montreal, tubes, $10,840.
- Technical Enterprises Ltd., Toronto, components, $10,945.

December 1-15, 1959

- Ahearn & Soper Co. Ltd., Ottawa, tubes, $13,330.
- Amphenol Canada Ltd., Toronto, electrical cable, $11,337.
- Canadian Aviation Electronics Ltd., Montreal, spares for armament systems test equipment, $20,676.
- Canadian General Electric Co. Ltd., Toronto, tubes, $37,008.
- Canadian Marconi Co., Toronto, tubes, $39,413.
- Canadian Telephone Construction Co., Cap De La Madeleine, Que., extension of telecommunication cable, $13,672.
- Computing Devices of Canada Ltd., Ottawa, equipment, $82,157.
- Electric Storage Battery Co. (Canada) Ltd., Toronto, batteries, $35,532.
- Fairey Aviation Co. of Canada Ltd., Dartmouth, N.S., installation of electronic equipment in aircraft, $105,544.
- Instronics Ltd., Stittsville, Ont., oscilloscopes, $13,050.
- RCA Victor Co. Ltd., Ottawa, components, $11,316.
- Raytheon Canada Ltd., Ottawa, tubes, $88,966.
- Technical Enterprises Ltd., Toronto, components, $11,228.

New products—cont.

Profile monitor 129

Model 201 profile monitor provides a visual display of any phenomena measurable by an electrical output; temperature, pressure, strain and velocity. With accommodations for as many as 90 inputs, the monitor can display one of these phenomena, or any combination having comparable electrical outputs. Full scale sensitivities range from 0 - 10 mv peak to peak, to 0 - 150 v peak to peak. Any three consecutive decades in this range can be provided to fit customer requirements.

Advanced Technology Laboratories, Mountain View, Calif.

Analogue tutor trains personnel 130

Analogue tutor type TY 963 is a simplified analogue computer intended for educational applications. It is capable of representing any form of the linear second-order differential equation using the built-in computing components and demonstrating, for example, the effects of velocity and acceleration limits using external diodes as additional computing impedances. Within the limitations imposed by the total complement of five amplifiers, a wide range of physical systems may be represented. These include simple servos, electrical networks, the motion of a particle under gravity, etc.

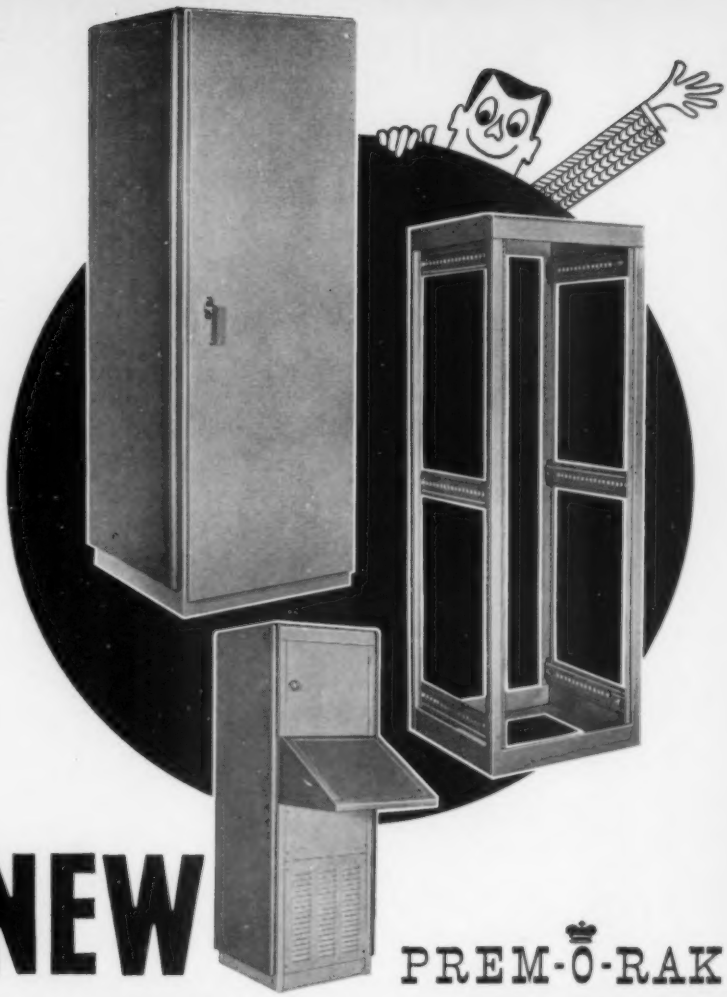
The Solartron Electronic Group Ltd., Thames Ditton, Surrey, Eng.

Bonding aid 131

Acton fluoroetch solution is a prepared etching solution for making fluorocarbon polymers (such as Teflon) bondable to other materials. It is an activated form of sodium in solution and reacts with fluorocarbon resin, extracting fluorine atoms at the surface with the formation of a carbonaceous film which is compatible with most adhesives. Fluorocarbon polymers are thus made easily bondable to other materials by conventional methods.

Acton Laboratories, Newark, N.J.

(Continued on page 66)



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Designed for MULTIPLE INSTALLATIONS and for use with PREM-O-RAK CONSOLE SYSTEMS

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PREMIER METAL PRODUCTS CO.

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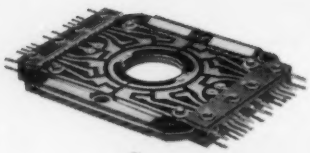
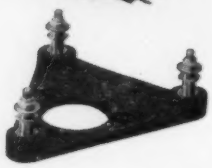
Psychlo-switch*

A multiple-strand precious metal brush fixed to a rotating arm . . .

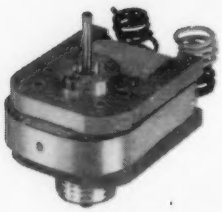


engaging a flush printed circuit with nickel-rhodium plated conductors

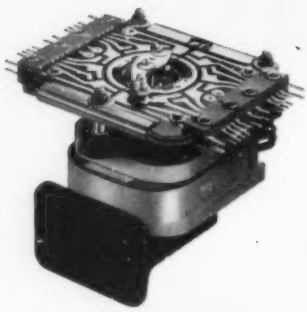
. . . is a proven switching method.



Joined to the fast and durable Sigma Cyclonome® Stepping Motor . . .



results (obviously) in a fast and durable stepping switch, imaginatively entitled the Cyclo-switch. Since the principal component is the Cyclonome motor, all its characteristics apply to the Cycloswitch: operation on magnetic reversals (no reciprocating parts), with each reversal producing exactly 18° of shaft rotation. The Cycloswitch will seek out and stop at any one of its 10 and/or 20 positions on command. It will run at either constant or random rates, up to 240 steps/sec. Power required varies from 1 to 10 watts, depending on speed and the number of brushes.



Brushes and switch segments will *carry* 1.5 amps in 250 VDC circuits; applications controlling Sigma relays with 20-40 ma from 120 VDC, with proper arc suppression, have given long, trouble-free service. Life up to 75,000,000 revolutions with light loads is possible.

All sorts of combinations of decks, arms, wipers, brushes and delivery schedules are possible. The simple one-deck two-brush model shown lists for $95; in production quantities the price drops down to about $50. By now we hope you're interested in inquiring further about the Sigma Series 9C "Cycloswitch."

**for psynchopated switching*

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34 Pearl St., So. Braintree 85, Mass.

AN AFFILIATE OF THE FISHER-PIERCE CO. (Since 1939)

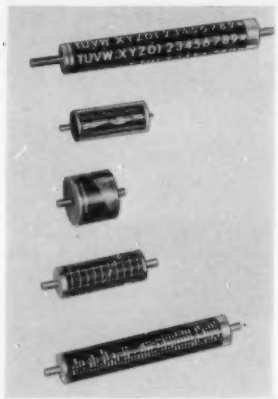
For further information mark No. 47 on Readers' Service Card

New products—cont.

Code and Switching drums 132

These code drums and switching units use imbedded and flush circuitry in a circular or tubular form. They find application in automation, telemetering and control devices. Shafts can be metallic or non-metallic; any diameter or length; round, slotted, pointed, etc. Conducting areas can be copper, brass, silver, or other metal or alloy, and may be bare or plated. Insulation is flush with the conducting areas and may be epoxy or other resins with or without fillers.

Beck's, Inc., St. Paul, Minn.



Cold cathode trigger tube 133

Subminiature cold cathode trigger tube type Z70W uses two starters. It has been designed for application where forward and backward counting is required in counting circuits. It also helps to simplify such circuits as reset positions, gates, etc.

Rogers Electronic Tubes & Components, Toronto.

Figure read-out indicator 134

Decade numerical indicator tube type Z510M provides a direct figure read-out. It has a special 13-pin base, figures measuring 1 cm in height, and figures from 0 to 9 in red neon color. The tube with its ten figure-shaped cathodes cannot count itself, but forms a read-out for slow cold cathode counters, as well as for fast vacuum tube, trochotron or transistor counters.

Rogers Electronic Tubes & Components, Toronto.

Signal comparator 135

Comparatron performs continuous digital comparison of command and feedback signals and produces an accurate analog drive signal. Two models are available — one accepting up to two 24-bit parallel binary numbers, and the other up to two 24-bit parallel binary-coded decimal digits. Input data may be presented from a storage register, hand set switches or shaft encoder. By a

process of digital comparison, an error-modulated ac output is produced for direct use as a positioning signal.

The output signal is 60-1000 cps (dependent on power supply) error modulated ac voltage with an amplitude of 23 mv peak-to-peak per unit error for the pure binary model, and 15 mv peak-to-peak per unit error for the binary-coded-decimal model. The units were developed by Norden Division of United Aircraft Corp.

Canadian Pratt & Whitney Aircraft Co. Ltd., Montreal.

Portable precision voltmeter 136

Hallamore model 1081 voltmeter, a dc potentiometer type, combines an electronic galvanometer with a precision resistor network to enable dial readings down to 0.5 microvolts resolution and up to 10 volts dc at an accuracy tolerance of $\pm(0.025\% + 3$ uv). The resistor network is controlled by six decade switches covering voltage ranges from $\pm$ 10 uv to $\pm$10 volts. The meter contains its own power supply and standard cell for calibration purposes.

General Sound & Theatre Equipment Ltd., Toronto.

Tap-proof phone cable 137

Companies using tv, telephone, or wire photos in internal communications networks, can be sure that their lines are free of eavesdroppers by means of this tap-proof, tamper-proof cable. The communications circuits are covered by successive layers of foil sheathed in plastic and connected to a sensitive relay circuit which responds to changes in electrical current as low as two-one millionths of an ampere. Attempts to tap the wire activate a relay causing an alarm to sound at a control point. The insertion of a pin into the cable will trip the alarm.

Additional protection against inductive tapping is provided by a noise generator which transmits a signal greater than the amplitude of a conversation carried in the cable. The noise covers the complete audio frequency range and cannot be eliminated by filters.

Mosler Research Products, New York.

10 mc transistor counter-timers 138

Three new all-solid state dc to 10 mc counting, timing and frequency measuring instruments have been introduced by Computer Measurements Co. Model 727A is a universal counter-timer; model 707A is a frequency-period meter; model 757A is a time interval meter.

The model 727A universal counter-timer combines the functions of a counter, time interval meter, and frequency/-period meter. It performs five basic functions selectable by a front panel switch and has measurement ranges of dc to 10 mc for frequency, 0.1 usec to 10^7 second for time interval, 0.1 usec for period. Frequency converters are available for higher frequencies.

Electromechanical Products, Agincourt, Ontario. END

Lafayette Radio INDUSTRIAL ELECTRONICS DIVISION

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its appointment as franchised distributor for

GENERAL RADIO Variac®

Continuously-Adjustable Autotransformers with Exclusive DURATRAK (Pat. Pending) Contact Surface.

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American Beauty electric soldering irons are the highest quality made. The finest engineering, best materials and on-the-job experience since 1894 is yours with every American Beauty. There is a right model, correct tip size and proper watt input to do any soldering job easier, faster and better.

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HUNT R.C.E. for PRINTED CIRCUIT BOARDS
(Rapid Circuit Etch)

Hunt R. C. E. is a proprietary etchant, formulated to etch printed circuits fast and to speed up production. It offers these 6 big advantages:

- 15% increase in etching speed
- Fast action over entire circuit
- Uniformly smooth etching
- Easily removed by washing
- Substantial increase in capacity
- Freedom from fumes

HUNT S.C.E. for SOLDER-PLATED CIRCUIT BOARDS
(Solder Circuit Etch)

This ready-prepared product is designed to etch solder-plated circuit boards more easily, more effectively than it has ever been done before. You'll find that Hunt S. C. E.

- Etches rapidly at room temperatures
- Has a high capacity for copper
- Never attacks the circuit
- Has guaranteed uniformity, and is of the highest quality because of rigid laboratory control

Hunt S. C. E. is essentially an oxidizing solution with the capacity to keep the oxidized copper permanently in solution. Although many acids will etch copper, S. C. E. solution has the peculiar property of not attacking the solder . . . but giving fast, odorless etching of the copper.

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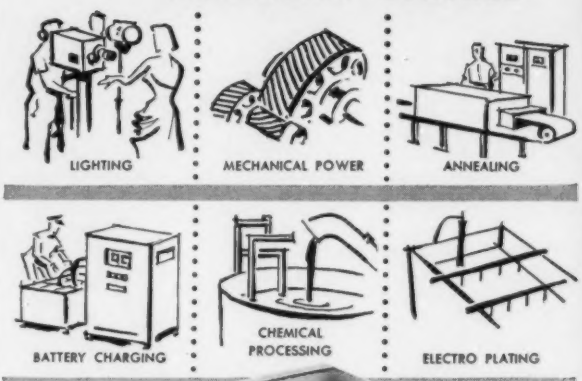
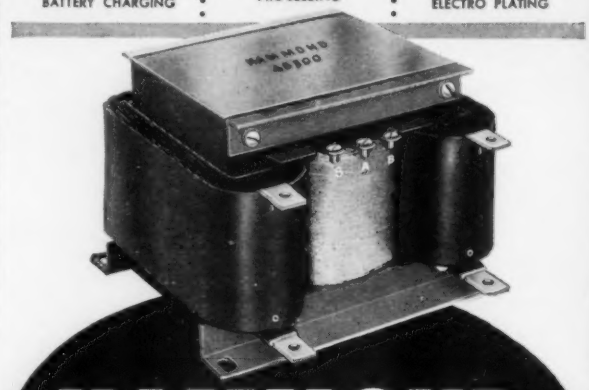
SMOOTH AND PRECISE ELECTRONIC CONTROL





HAMMOND SATURABLE REACTORS

Hammond Saturable Core Reactors will control large A.C. powers with small amounts of D.C. Current. They are highly efficient, completely reliable and require no maintenance.

Available in all sizes, from milliwatt level to 50 kilowatts, and for all commercial power frequencies including 400 cycle. A typical Hammond Saturable Reactor, when connected in series with a load, will vary the load voltage from 10% to 95% of line voltage. The D.C. power requirements are generally 2% of the controlled power. The Reactor may be remotely controlled by a small potentiometer.

Saturable reactors are not expensive and have numerous varied applications throughout industry.

Write for Bulletin 5057.

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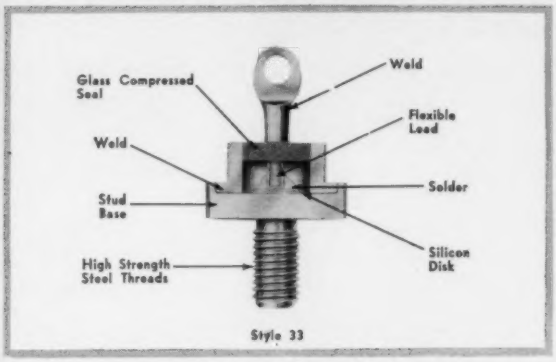
specify reliable
all STEEL construction
Silicon Rectifiers
by *SYNTRON*



Style 33

SYNTRON'S exclusive all STEEL assembly — high tensile strength — 100% welded construction

100 inch pound mounting torque for maximum heat transfer—less corrosion—greater reliability—better contact. Mechanically and electrically superior.

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These Hughes fused junction transistors offer the following advantages:

- BV $_{CBO}$, BV $_{EBO}$ and BV $_{CEO}$ are symmetrical—7 styles from 15 to 110 volts.
- Low leakage current . . . —0.1 microamps max.
- Low saturation resistance.
- Higher operating frequency.
- All electrodes insulated from can.
- Standard TO-5 outline.

*The equivalent units in the famous Hughes coaxial package (illustrated) dissipate 1 watt.

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TMC

Control Key Switches

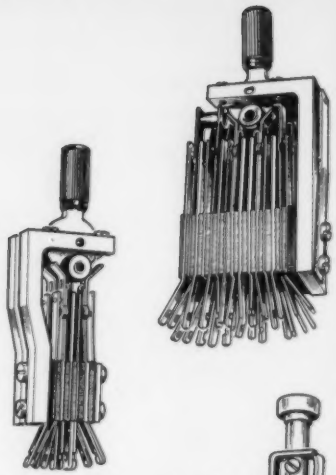
for **LOW VOLTAGE MULTIPLE SWITCHING**

T.M.C. CONTROL KEY SWITCHES, precise in design and of robust construction, are today performing their vitally continuous work in varying apparatus all over the world.

Operators feeling the clean and positive "Make and break" action in any of the fifty standard spring combinations forget any fear of failure.

The contact springs made of nickel silver operated by hard plastic rollers on steel cams and silver contacts, ensure perfect performance. (Platinum or other metal can be supplied for special operating conditions.)

Telephone EM. 6-5314 or write for T.M.C. Control Key Catalogue giving full technical data to:



Lever type control key switches (above)

Plunger type control key switches

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NATIONAL RESEARCH COUNCIL requires two MAINTENANCE TECHNICIANS

to conduct under direction preventive maintenance and trouble shooting of two electronic computers (Analog and Digital).

The minimum educational requirement is Senior Matriculation with high academic standing, especially, in Mathematics. Preference will be given to electronic course graduates from advanced Technological Institutes. Some experience in the electronic field would be an asset.

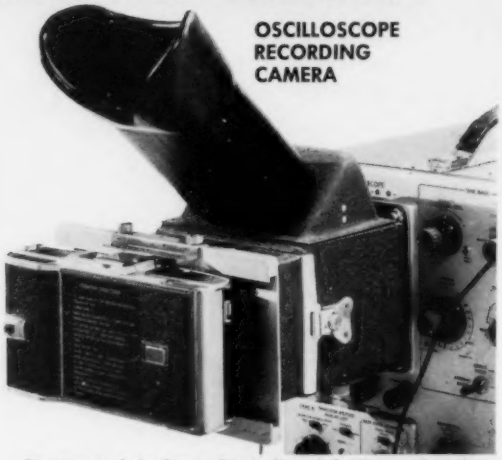
The positions offer initial salaries of up to $5100 per annum, depending on training and experience.

Applications giving age, telephone number and complete details of education and experience should be submitted to the Employment Officer

National Research Council,
Sussex Drive, Ottawa 2

Please quote file ME-1.

NEW! BEATTIE-COLEMAN DIRECT VIEW OSCILLOTRON



The newest of the famous Beattie line of Oscilloscope Recording Cameras is rugged, versatile and of the highest design quality. Camera mount easily attaches to the standard 5.6" scope bezel by means of the new light-sealed split clamp ring. No external support necessary. Uses Polaroid Land Camera back with either 1:0.9 Adapter or 1:0.74 Multiple Exposure Adapter which provides up to ten exposures on a single frame. Accessories include Electric Shutter Actuator, Adapters for Sheet and Roll Film, Adapter for 3" Scope and Closure Plate.

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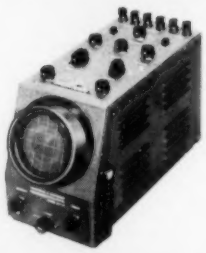
WATERMAN POCKETSCOPE

MODEL S-11-A INDUSTRIAL



The Industrial Pocketscope, Model S-11-A, has earned the title "Work Horse of the Industry" by its demonstrated reliability.

This Pocketscope leader is ideal for most industrial work and is especially useful on many circuits using thyratrons, rectifiers, etc. It is used extensively for servicing the most sensitive signaling and communication networks. It enjoys world-wide popularity due to unique performance, small size, light weight and low, low price.

PAYETTE RADIO LTD.

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THE CASE OF THE FOURTH FOOT*

EVIDENCE

A. Drop sensitive multimeter four feet onto cement floor. Sweep up pieces before proceeding with next step.

B. Place identical meter in Pylon transit case, Type TC-4.

C. Drop case four feet onto cement floor.

D. Repeat step (C) until tired of sport. Tests will show meter unharmed.

PRECEDENT

The TC-4 has been upheld in trials by major electronic equipment users from coast to coast in Canada.

SUMMARY

Pylon presents a very solid case — one that continues to win support from many learned experts.

VERDICT

The Pylon TC-4 offers unsurpassed protection for electronic equipment.

* *Four feet is the mean distance your favorite shipper likes to drop electronic equipment, according to a recent government survey. Airlines average slightly more.*

PYLON

PYLON ELECTRONIC DEVELOPMENT company, ltd.

Communications Systems and Equipment

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For further information mark No. 41 on Readers' Service Card

USSR gains force reassessment of our scientific policies

Placing a man on the moon may have short-term political advantages, but the real objective in space research should be the long-term scientific advances, claims Dr. Arthur R. Kantrowitz, director of Avro-Everett Research Laboratory.

Dr. Kantrowitz expressed this view at a press conference preceding his address to the Toronto branch of the Engineering Institute of Canada, January 14.

Space research is a large undertaking that requires a great deal of understanding between scientists and the tax paying public. Unlike a purely military project in which patriotism leads the public to unquestioning support, space research requires an adventurous spirit on the part of the public.

This is one of the basic differences between our society and a totalitarian state, and Dr. Kantrowitz thinks it quite significant that the USSR has chosen space research as an area in which to compete with Western nations.

Placing a man on the moon is not as important in the long run as making good scientific advances. But the United States should enter into the venture with more enthusiasm and resources, said Dr. Kantrowitz, and in this way prove the ability of a democratic society to provide leadership in research.

Some of the handicaps under which United States scientists work can best be described by recalling two important events that took place October 4, 1959. In the USSR, a rocket was launched to obtain photographs of the far side of the moon. In the USA, Miss America of 1960 was crowned.

Science teacher wins award

Howard L. Eubank, vice-principal of Etobicoke Collegiate in Metropolitan Toronto, has been chosen Ontario's outstanding mathematics and science teacher of the year.

The award was established last year by the Association of Professional Engineers of Ontario to recognize the contribution made to the engineering profession by the secondary school teachers in mathematics and physics. Selection of the outstanding teacher is made by the Ontario Secondary School Teachers Federation.

Mr. Eubank is co-author of two school text books: Basic Physics for Secondary Schools (used in grade 11 of Ontario schools) and Physics for Secondary Schools (authorized for use in Alberta).

On January 12, members of the Toronto Section of IRE visited the printing plant of Maclean-Hunter Publishing Co. Ltd. Staff of CEE were hosts.

Papers wanted for computing conference

The Computing and Data Processing Society of Canada is seeking papers for their second conference to be held at the University of Toronto on the 6th and 7th of June, 1960.

Presentation of papers should be limited to 30 minutes to be followed by a brief discussion period. Submission of paper titles accompanied by a 200-word abstract must be forwarded no later than February 15, to Mr. A. P. Macfarlane, 620 University Avenue, Toronto 2.

Student orators

On Thursday, February 18, four students from Ryerson Institute of Technology and the University of Toronto will participate in the annual competition for student speakers at a joint meeting of the Toronto Sections of the American Institute of Electrical Engineers and the Institute of Radio Engineers. Prizes will be awarded the three best speakers chosen by a panel of judges. The meeting will be held at Cody Hall, 50 St. George St., Toronto.

Industry aids education

Canadian industry continues to increase its acceptance of The University of Waterloo's co-operative engineering students. Some 380 students, the largest number to be placed with industry at one time, are now engaged in work assignments with more than 250 Canadian companies and organizations throughout Ontario and Quebec.

The university's co-operative engineering course is unique in Canada. The students alternate three-month sessions on the campus with similar periods for industry. The course is five years in length and it is expected that more than 800 students will be enrolled by next fall.

COMING EVENTS

February

19-23 Third International Exhibition of Electronics Components, Paris, France.

22-26 Engineering Materials and Design Exhibition, Earls Court, London.

March

7 Toronto Section IRE annual stage night, Four Winds, Toronto.

21-24 IRE International Convention and Radio Engineering Show, New York.

April

4-8 6th Nuclear Congress, N.Y. Coliseum, New York.

5-9 9th Electrical Engineers Exhibition, Earls Court, London.

May

2-4 National Aeronautical Electronics Conference, Dayton, O.

3-5 8th Annual Conference on Electromagnetic Relays; National Association of Relay Manufacturers, Stillwater, Oklahoma.

23-28 3rd International Instruments, Electronics and Automation Exhibition, Olympia, London.

New products review

Recognizing the great advances that have been made in instrumentation, CEE has increased the scope of its new products review this year to include special reports on oscilloscopes and signal generators. These will contain comparative tables of performance specifications.

In addition, the March issue will contain extra pages devoted to news of electronic products that have been introduced to the market within recent months. They will include components, instruments, equipment and other products.

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Keep your reference shelf up to date this easy way. All advertisements, new products and literature in this issue have a key number. For more information

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